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TEST RECORD NO: STECS-AE-S-59	TEST RECORD U.S.ARMY COMBAT SYSTEMS TEST ACTIVITY ABERDEEN PROVING GROUND, MARYLAND 21005-5059	DATE OF RECORD: 26 JUL 1990
DATE(S) OF TEST: 16-31 May, 1990		AUTHORITY: TECOM Test Dir STEBE-FES 27 Dec 1989
TYPE OF TEST: Technical Road Testing of the 18,000 BTU Air Conditioners (Vibration Profile)	USATECOM PROJECT NO: 8-EG-175-018-035	REQUESTING AGENCY: US Army Ft. Belvoir RD&E Ctr
		CONTRACT NO: Not Applicable
		WORK ORDER NO: 330-63012-40

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OBJECTIVE(S) OF TEST

The objective of this test was to record the frequencies and magnitudes of vibration and shock force inputs at various specified locations of the air conditioner during the normally expected life cycle transportation environment.

TEST ITEM(S)

Two 18,000 BTU (horizontal, compact) air conditioners (A/Cs) were mounted in a standard S-280 shelter in a manner consistent with normal (historical) location and hardware. Upon arrival at U.S.Army Combat Systems Test Activity, Aberdeen Proving Ground, MD. (USACSTA), the shelter assembly was loaded on a 2 1/2 ton truck and secured using standard tiedowns and procedures. To produce a worst case (maximum shock and vibration) profile for truck mounted equipment, the shelter was empty except for the installed air conditioners. The truck was not weighted with any additional ballast.

TEST FACILITIES

The testing was conducted on road courses at the Munson And Perryman test areas of Aberdeen Proving Ground. The vibration and shock environments for the test were derived from discussions between Belvoir R D & E Crt and USACSTA. The various courses represent a wide selection of the severety of possible transport environments that the A/Cs may be subjected to during a normal life cycle. The limited mileage of the conducted testing was not intended to represent the total equivalent wear of a life cycle of normal use.

Three tri-axial accelerometers were installed on the roadside A/C at the locations marked by the test sponsor. The instrumented testing consisted of the minimum duration period required to monitor a representative sample of each test course at each selected ground speed. Operational speeds of the test vehicle were controlled by a pace vehicle equipped with a calibrated fifth wheel driven speedometer. Instrumented testing was conducted on the Munson area improved gravel road, Belgian block, two-inch washboard, three-inch spaced bump, and six-inch washboard test courses, and the Perryman PT1 level cross-country road course. Detailed course descriptions are contained in TECOM TOP 1-1-011.

The accelerometer data outputs were relayed to high speed magnetic tape at an onsite mobile computerized data collection van. All data was validated at the time of the test. Data reduction to the format requested by the sponsor was accomplished with the use of special computer programming developed at USACSTA. Details of the instrumentation installation, monitoring, and data reduction are contained in the engineering report (Encl 1).

TEST RECORD NO: STECS-AE-S-59 (Continued Use additional sheets, if required)

REMARKS

Prior to any testing the operation of the A/Cs was checked. The A/Cs were connected to a portable electrical generator power supply. Operation was confirmed by listening to the fan unit operate, and confirming cool air was circulated inside the shelter and heated exhaust air was discharged from the A/C unit. The checks were performed by the sponsor representative. No instrumented measurements were required for the operational unit. This brief operational capability confirmation check was performed after the completion of the instrumented data collection for each different test course.

In addition to the instrumented mileage, some noninstrumented mileage was accumulated to complete the sponsor's requested testing. The operation of the A/C units was confirmed by USACSTA personnel at the completion of all testing in the same manner as above. At the request of the test sponsor, an additional 150 miles of noninstrumented transportability test operation was conducted on the Perryman PT1 cross-country test course.

The total mileage accumulated during the testing at USACSTA is not considered a significant portion of the total life cycle mileage for the shelter mounted A/Cs and is not considered conclusive of any findings of operational capability or endurance.

The recorded data of the frequencies and magnitudes of vibration and shock force inputs at various locations of the air conditioner was reduced to a series of plots of Power Spectral Density (g^2/Hz) for each displacement axis at each monitored location. Each chart is identified by test course and ground speed information. The data is provided to the sponsor in the requested formats. The data may be used to produce a random-on-random vibration table schedule for an input more realistic of actual conditions than the outdated sine sweep schedule currently used for laboratory test screening and development of A/C units. The data will be compared to current specifications to determine if changes in future production requirements should be made.

A detailed presentation of the test setup, instrumentation and data interpretation is presented in the Engineering Report (Encl 1).

This is the final report for this project.

OBSERVERS

Nicholas Schultz	USABRDEC
Leigh Sanders	USACSTA
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SIGNATURE:

LEIGH A. SANDERS, TEST DIRECTOR

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ENGINEERING TEST DIVISION

VIBRATION TEST BRANCH

USATECOM PROJECT NO. 8-EG-175-018-035

DATE: 27 June 1990

REPORT NO. 90-LR(V)-62

TECHNICAL ROAD TEST

OF

18,000 BTU AIR CONDITIONERS

(ROAD VIBRATION TEST)

DATES OF TEST: 16 through 31 May 1990

PREPARED BY: R. A. McKINNON

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U.S. ARMY COMBAT SYSTEMS TEST ACTIVITY
ABERDEEN PROVING GROUND, MARYLAND

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SECTION 1. EXECUTIVE DIGEST

1.1 SUMMARY

The shock isolators under the air conditioners did not attenuate the vibration energy to the air conditioner while the isolators under the compressor did reduce the energy over the upper parts of the 0 to 500 Hz frequency band.

The air conditioner compressor was subjected to shocks caused by its impacting other components.

The vibration test schedules developed and listed in Appendix B are dependent upon the transport scenario given in ITOP 1-2-601, 1 March 1988. This was used because the sponsor was unable to provide an item specific transport scenario. Changes in the total transport distance and/or the percentage of fatigue inducing road surfaces will affect the laboratory test time.

1.2 TEST OBJECTIVES

The objectives of this test were:

a. To determine the vibration environment during road operations.

b. To develop laboratory vibration test schedules to simulate the field environment.

c. To determine the ability of the 18,000 BTU air conditioners to operate after exposure to the field vibration environment.

1.3 TESTING AUTHORITY

None.

1.4 TEST CONCEPT

The 18,000 BTU air conditioners were subjected to road vibration testing. The testing was conducted from 16 through 31 May 1990. The Vibration Test Branch of the U.S. Army Combat Systems Test Activity (USACSTA), Aberdeen Proving Ground (APG), MD was responsible for instrumenting the test item, conducting the test, and acquiring and processing all test data.

1.5 SYSTEM DESCRIPTION

Two 50/60 Hz, 3-phase, 208-volt, 18,000 BTU/hr compact horizontal air conditioners, KECO Model No. F18H-3SB, were installed in the front of an empty S280(B)/G shelter (SN 138) as shown in Figure B-1. The air conditioners weigh approximately 77 kg (170 lb) each. A rubber grommet was located above and below the mounting bracket at each of the four air conditioner mounting bolts. Four rubber shock isolators were installed at the base of the compressor.

SECTION 2. SUBTESTS

2.1 ROAD VIBRATION TEST

2.1.1 Objectives

The objectives of this test were:

a. To determine the vibration environment during road operations.

b. To develop laboratory vibration test schedules to simulate the field environment.

c. To determine the ability of the 18,000 BTU air conditioners to operate after exposure to the field vibration environment.

2.1.2 Criteria

None.

2.1.3 Test Procedure

The empty S-280 shelter, housing the two air conditioners, was loaded and secured in the bed of an M35A2C 2-1/2-ton 6x6 dropside cargo truck (VIN: NK080J 0640-10781) (fig. B-1). The truck was equipped with size 9.00-20 tires, Load Range D, inflated to 345 kPa (50 psi). The roadside air conditioner (SN 873466) and mounting hardware were instrumented with nine uniaxial piezoresistive accelerometers arranged in three orthogonal axes as specified by the test sponsor. The curbside air conditioner (SN 873480) was not instrumented. Photographs of the accelerometer locations are included in Figures B-2 through B-4. Table B-1 contains the locations and specifications of the accelerometers used during this test.

An on-board pulse code modulation (PCM) data acquisition system was used to acquire data during the various test configurations. A detailed description of the acquisition system is presented in Appendix G.

Prior to testing, an electrical calibration was performed on all channels. The accelerometers were calibrated by shunting the transducer with a calibrated resistor which produced a differential electrical output equivalent to a calculated acceleration. This calibration was performed in both the positive and negative directions.

A linear least squares curve fit was performed on the calibration data to determine system linearity and to provide a quality check on the calibration data. Any channels which demonstrated high noise levels, DC offsets, and/or nonlinearities could, thereby, be detected and corrected before test initiation.

2.1.3 (Cont'd)

Vibration data were acquired while the air conditioners were transported over the test courses at the speeds listed in Table 2.1-1. The speeds were determined from a fifth wheel and indicating head mounted on a pace vehicle. An attempt was made to input the vehicle speed from the prime mover's speedometer into the data stream. This was not done because the vehicle's speedometer cable was not functioning properly, therefore requiring the pace vehicle. Data were recorded for approximately 31 seconds during each different speed run on the test courses. The short length of two of the test courses (Radial Washboard and Three-Inch Spaced Bump) mandated that less data be acquired.

TABLE 2.1-1. TEST COURSES AND SPEEDS

Test Course	Speed km/hr	Speed mph
Belgian Block	8, 16, 24, 32	5, 10, 15, 20
Two-Inch Washboard	16	10
Radial Washboard	24	15
Three-Inch Spaced Bump	32	20
Six-Inch Washboard	4, 8	2.5, 5
Perryman Paved	32, 48, 64, 80	20, 30, 40, 50
Perryman Cross-Country No. 1	8, 16, 24, 32	5, 10, 15, 20

The instrumented air conditioner was operationally checked periodically and at the conclusion of the road vibration test.

A limited amount of data processing was performed at the test site for the purpose of data verification immediately following the data runs. A more complete form of verification and all data analysis were performed on a separate computer system after the data acquisition process was completed. Data verification and analysis procedures are presented in more detail in Appendixes H and I.

The final data (after verification) were processed by performing the required Fourier transformations and creating power spectral density (PSD) files for the individual test runs. A summary of the parameters used to compute the PSD functions are presented in Table 2.1-2.

TABLE 2.1-2. PSD COMPUTATION PARAMETERS

Parameter	Value
Sample rate, Hz	2083.333
Block size	2048
Frequency bandwidth, Hz	1.017
Windowing	Hanning
Number of linear spectral averages	32

2.1.3 (Cont'd)

Amplitude distributions (rms, +peak, -peak, +99.9 percent, -99.9 percent, +99 percent, and -99 percent) were performed on all channels for each run. The amplitude distribution data were compiled (tables B-2 through B-7) by histogramming the data into a 512-bin field and calculating cumulative distributions. The average value for each channel was removed to account for DC offsets in the instrumentation. The peak values presented in this report are the true peaks, unlike previous Vibration Test Branch reports which reported the 99.9-percent value as the peak value in order to remove extraneous noise from the data. The current data verification procedure is able to identify noisy data so it can be eliminated from the analysis.

The laboratory vibration test schedule development process is started by grouping (overlaying) PSD data of the mounting bracket for critical speed runs on four of the Munson test courses. The courses and speeds selected were the ones traditionally used in the development procedure and are listed in Table 2.1-3. These PSDs are overlayed to provide a composite spectrum.

TABLE 2.1-3. VIBRATION SCHEDULE TEST COURSES AND SPEEDS

Test Course	Speed km/hr	Speed mph
Belgian Block	32	20
Two-Inch Washboard	16	10
Radial Washboard	24	15
Three-Inch Spaced Bump	32	20

The overlay process was accomplished by using the individual average plus one standard deviation spectra for the grouped conditions. The use of the average plus one standard deviation is intended to add some level of conservatism to the data. For the individual spectra, the addition of a standard deviation has the effect of slightly more than doubling the average value while the addition of the standard deviation during the overlay process with a sample size as small as two runs has the effect of enveloping the data.

The overlayed data were then exaggerated to reduce the laboratory test time to a more reasonable value. A real world exposure time for cross-country operation was calculated to be 330 hours, based on the average speed of the four test courses utilized and the expected total transport distance listed in ITOP 1-2-601 dated 1 March 1988 40,000 km (25,000 mi). For a wheeled vehicle, it is customary practice to ignore the vibration levels from smooth terrains since those levels are normally lower than those measured while the vehicle operates on cross-country surfaces. Sixty-five percent of the total distance is assumed to be on cross-country surfaces. One-third of the cross-country distance is assumed to be of the severity of the Munson Test courses. This reduced the distance to 8,700 km (5,400 mi). In order to reduce the laboratory test time an exaggeration factor of 2.0 was applied to the data. This amplification reduced the test time to 24.5 hours for each of the three axes.

This is still a relatively long time for a laboratory vibration test; however, the exaggeration factor was limited to 2.0 because it is unreasonable to amplify the data to such an extent that the test level will exceed the yield or ultimate strength of the material. The schedules are included in Figures B-5 through B-7. Table B-8 contains the breakpoints for these laboratory vibration schedules. A more detailed description of the air conditioner environment schedule development is presented in Appendix J.

Frequency response (transfer) functions were performed by dividing response PSD by their corresponding input PSD and taking the square root of the result. This is discussed further in Appendix I.

2.1.4 Test Findings

There was no visible damage to the air conditioners as a result of the road vibration test. The air conditioner was operational throughout and at the conclusion of the road vibration test.

The acceleration data were analyzed in the form of amplitude distributions (tables B-2 through B-7), time history plots, and power spectral density plots (fig. B-8 through B-15).

The acceleration levels increased on each course as the vehicle speed increased. All of the test courses with the exception of paved road had a critical speed in which the accelerometers on the compressor measured shock loading. A typical time history plot showing these shock pulses is included in Figure B-17. These shock pulses were present at all of the measured speeds above the critical speed.

The frequency response functions indicate that the vibration energy was amplified through the shock mounts located at the bottom of the air conditioner (fig. B-18 through B-20). The frequency response functions between the compressor and the compressor mounting bracket show attenuation in the vertical direction throughout almost the entire 0 to 500 Hz band (fig. B-21). The transverse and longitudinal transfer function plots show attenuation above 200 and 325 Hz, respectively (fig. B-22 and B-23).

2.1.5 Technical Assessment

The shock isolators under the air conditioners did not attenuate the vibration energy to the air conditioner while the isolators under the compressor did reduce the energy over the upper parts of the 0 to 500 Hz frequency band.

The air conditioner compressor was subjected to shocks caused by its impacting other components.

2.1.5 (Cont'd)

The vibration test schedules developed and listed in Appendix B are dependent on the transport scenario given in ITOP 1-2-601, 1 March 1988. This was used because the sponsor was unable to provide an item specific transport scenario. Changes in the total transport distance and/or the percentage of fatigue inducing road surfaces will affect the laboratory test time. The control accelerometer for the laboratory vibration testing should be placed in the same location as where the data were obtained (fig. B-4). The air conditioners undergoing the laboratory test should also be mounted to the vibration exciter in an identical manner as those during this road test.

SECTION 3. APPENDIXES

APPENDIX B - TEST DATA

TABLE B-1. TRANSDUCER LOCATIONS AND SPECIFICATIONS 18,000 BTU AIR CONDITIONER TEST

Channel No.	Description	Axis	Manufacturer	Model	SN	Due Cal	Freq Range, Hz	Range, g	Resolution, g
1	Compressor base	Vert	Endevco	2262C	ND05	18 Jul 90	0-500	±45.5	.089
2	Compressor base	Tran	Endevco	2262C	BN01	01 Sep 90	0-500	±65.9	.129
3	Compressor base	Long	Endevco	2262C	NN62	18 Dec 90	0-500	±51.7	.101
4	Compressor top	Vert	Endevco	2262C	AD43	28 Feb 91	0-500	±64.7	.126
5	Compressor top	Tran	Endevco	2262C	ND13	28 Jul 90	0-500	±48.3	.094
6	Compressor top	Long	Endevco	2262C	BJ01	30 Aug 90	0-500	±57.4	.112
7	Air cond mounting bracket	Vert	Endevco	2262C	BN63	09 Aug 90	0-500	±26.1	.051
8	Air cond mounting bracket	Tran	Endevco	2262C	LK35	28 Mar 91	0-500	±25.9	.051
9	Air cond mounting bracket	Long	Endevco	2262C	LT27	28 Nov 90	0-500	±20.7	.040

TABLE B-2. ACCELERATION AMPLITUDE DATA

Run Number 1

Belgian block 5 mph 18k BTU air conditioners 16 May 90

Description	rms	+Peak	-Peak	+99.9%	-99.9%	+99%	-99%	+90%	-90%
(L) Air cond mounting bracket	.19	.94	-1.69	.69	-.87	.45	-.54	.20	-.21
(T) Air cond mounting bracket	.30	1.25	-1.52	.94	-1.00	.74	-.70	.33	-.39
(V) Air cond mounting bracket	.20	1.14	-1.01	.73	-.70	.52	-.50	.22	-.29
(L) Compressor top	.26	3.12	-3.94	1.50	-1.46	.64	-.70	.26	-.31
(T) Compressor top	.52	9.37	-9.68	4.70	-4.29	1.19	-1.14	.47	-.51
(V) Compressor top	.23	2.72	-2.74	1.19	-.99	.54	-.67	.32	-.23
(L) Compressor bottom	.22	3.17	-3.61	1.22	-1.14	.60	-.53	.19	-.22
(T) Compressor bottom	.36	4.90	-3.85	1.54	-1.61	.86	-.93	.41	-.48
(V) Compressor bottom	.26	3.33	-3.85	1.51	-1.49	.60	-.67	.33	-.31

TABLE B-3. ACCELERATION AMPLITUDE DATA

Run Number 2

Belgian block 10 mph 18k BTU air conditioners 16 May 90

Description	rms	+Peak	-Peak	+99.9%	-99.9%	+99%	-99%	+90%	-90%
(L) Air cond mounting bracket	.30	1.82	- 1.97	1.08	-1.31	.75	- .81	.34	-.32
(T) Air cond mounting bracket	.31	1.63	- 1.35	1.11	-1.04	.81	- .73	.40	-.42
(V) Air cond mounting bracket	.30	2.23	- 1.65	1.31	-1.04	.80	- .73	.39	-.32
(L) Compressor top	.57	16.65	- 8.25	3.68	-4.24	1.58	-1.57	.53	-.52
(T) Compressor top	.95	14.08	-13.31	7.26	-7.48	2.94	-2.80	.70	-.65
(V) Compressor top	.42	10.55	- 6.16	2.03	-2.23	1.05	-1.14	.50	-.48
(L) Compressor bottom	.54	9.00	-15.14	3.76	-3.84	1.50	-1.48	.47	-.45
(T) Compressor bottom	.63	13.87	-20.58	5.23	-3.86	1.64	-1.50	.51	-.61
(V) Compressor bottom	.61	22.77	-23.35	3.30	-3.61	1.48	-1.43	.57	-.52

TABLE B-4. ACCELERATION AMPLITUDE DATA

Run Number 6

Belgian block 20 mph 18k BTU air conditioners 16 May 90

Description	rms	+Peak	-Peak	+99.9%	-99.9%	+99%	-99%	+90%	-90%
(L) Air cond mounting bracket	.47	3.91	- 3.17	1.85	- 2.10	1.11	-1.36	.54	-.62
(T) Air cond mounting bracket	.35	2.67	- 3.43	1.64	- 1.57	.92	- .95	.40	-.43
(V) Air cond mounting bracket	.48	5.57	- 7.64	2.86	- 1.71	1.51	-1.09	.57	-.57
(L) Compressor top	1.12	27.92	-21.79	7.91	- 8.02	3.60	-3.50	.80	-.70
(T) Compressor top	1.08	18.70	-14.15	7.93	- 7.33	3.26	-3.56	.75	-.87
(V) Compressor top	.85	30.83	-15.02	6.45	- 7.70	1.81	-2.33	.59	-.63
(L) Compressor bottom	1.12	20.77	-33.74	8.98	- 7.84	3.18	-3.20	.86	-.88
(T) Compressor bottom	1.33	27.02	-36.58	12.72	-12.92	3.35	-3.06	.64	-.59
(V) Compressor bottom	1.83	42.31	-43.13	16.31	-21.35	3.64	-3.79	.77	-.75

TABLE B-5. ACCELERATION AMPLITUDE DATA

Run Number 11

6" washboard 5 mph 18k BTU air conditioners 16 May 90

Description	rms	+Peak	-Peak	+99.9%	-99.9%	+99%	-99%	+90%	-90%
(L) Air cond mounting bracket	.38	1.02	- 2.29	.85	-1.87	.77	-1.13	.44	-.55
(T) Air cond mounting bracket	.10	1.20	- .65	.79	- .45	.27	- .24	.07	-.14
(V) Air cond mounting bracket	.27	.89	- .98	.68	- .88	.58	- .67	.37	-.36
(L) Compressor top	.53	5.84	-14.78	4.96	-2.72	1.45	- .96	.36	-.52
(T) Compressor top	.16	2.05	- 3.25	.96	-2.16	.22	- .51	.04	-.14
(V) Compressor top	.20	1.04	- .92	.79	- .68	.55	- .43	.06	-.19
(L) Compressor bottom	.42	5.95	- 3.46	2.95	-1.06	1.34	- .86	.34	-.46
(T) Compressor bottom	.17	4.84	- 2.72	1.56	-1.46	.30	- .45	.05	-.20
(V) Compressor bottom	.27	2.11	- 1.57	1.23	- .70	.70	- .52	.18	-.35

TABLE B-6. ACCELERATION AMPLITUDE DATA

Run Number 15

Paved 50 mph 18k BTU air conditioners 17 May 90

Description	rms	+Peak	-Peak	+99.9%	-99.9%	+99%	-99%	+90%	-90%
(L) Air cond mounting bracket	.10	.46	-.76	.29	-.35	.21	-.27	.13	-.11
(T) Air cond mounting bracket	.08	.35	-.46	.25	-.36	.14	-.26	.04	-.06
(V) Air cond mounting bracket	.10	.46	-.46	.35	-.36	.25	-.26	.05	-.16
(L) Compressor top	.13	.53	-.59	.31	-.59	.08	-.37	-.14	-.14
(T) Compressor top	.11	.44	-.69	.25	-.50	.06	-.31	-.13	-.13
(V) Compressor top	.12	.57	-.94	.32	-.44	.07	-.19	-.19	.07
(L) Compressor bottom	.11	.48	-.73	.28	-.53	.07	-.33	-.13	-.13
(T) Compressor bottom	.11	.31	-.46	.31	-.46	.05	-.20	-.20	.05
(V) Compressor bottom	.10	.58	-.67	.22	-.49	.04	-.31	-.13	-.13

TABLE B-7. ACCELERATION AMPLITUDE DATA

Run Number 18

XC No. 1 15 mph 18k BTU air conditioners 17 May 90

Description	rms	+Peak	-Peak	+99.9%	-99.9%	+99%	-99%	+90%	-90%
(L) Air cond mounting bracket	.29	1.60	- 2.29	1.11	-1.15	.71	- .67	.30	-.34
(T) Air cond mounting bracket	.21	1.85	- 2.19	.94	- .98	.64	- .58	.23	-.27
(V) Air cond mounting bracket	.34	3.43	- 1.47	1.70	-1.16	.98	- .75	.37	-.34
(L) Compressor top	.54	14.93	-13.97	3.95	-4.33	1.49	-1.42	.37	-.53
(T) Compressor top	.69	16.73	-13.07	7.11	-5.71	1.83	-1.75	.32	-.43
(V) Compressor top	.41	9.93	- 7.43	1.66	-2.89	.90	-1.12	.40	-.36
(L) Compressor bottom	.46	11.86	-22.50	2.97	-3.30	1.15	-1.08	.34	-.47
(T) Compressor bottom	.49	15.03	-21.82	4.72	-4.04	1.12	-1.20	.08	-.43
(V) Compressor bottom	.64	21.30	-35.18	3.48	-4.00	1.34	-1.33	.45	-.44

TABLE B-8. LABORATORY VIBRATION TEST SCHEDULE BREAKPOINTS

Vertical		Transverse		Longitudinal	
Frequency	Amplitude	Frequency	Amplitude	Frequency	Amplitude
5.00	0.5555	5.00	0.0555	5.00	0.1014
6.00	0.1526	6.00	0.0455	6.00	0.0811
8.00	0.2911	7.00	0.0479	8.00	0.2739
9.00	0.2161	9.00	0.1171	9.00	0.2672
11.00	0.0399	10.00	0.1200	10.00	0.3101
13.00	0.0409	13.00	0.0277	14.00	0.0558
14.00	0.0537	14.00	0.0298	16.00	0.0587
15.00	0.0419	16.00	0.0233	17.00	0.0771
16.00	0.0475	19.00	0.0402	24.00	0.0394
21.00	0.0243	22.00	0.0291	27.00	0.0425
22.00	0.0311	22.00	0.0206	28.00	0.0315
26.00	0.0268	23.00	0.0245	30.00	0.0481
28.00	0.0163	25.00	0.0142	32.00	0.0357
30.00	0.0249	27.00	0.0182	35.00	0.0681
34.00	0.0319	28.00	0.0153	41.00	0.0698
35.00	0.0419	29.00	0.0191	47.00	0.0425
37.00	0.0379	34.00	0.0142	49.00	0.0648
39.00	0.0463	41.00	0.0245	56.00	0.0234
40.00	0.0379	45.00	0.0149	57.00	0.0366
42.00	0.0475	49.00	0.0338	69.00	0.0300
46.00	0.0335	54.00	0.0110	70.00	0.0385
49.00	0.0475	59.00	0.0264	74.00	0.0265
51.00	0.0268	63.00	0.0186	81.00	0.0447
54.00	0.0327	68.00	0.0444	122.00	0.0058
56.00	0.0163	69.00	0.0277	130.00	0.0096
58.00	0.0268	81.00	0.0613	150.00	0.0101
62.00	0.0176	85.00	0.0284	161.00	0.0061
64.00	0.0261	91.00	0.0383	178.00	0.0023
67.00	0.0163	149.00	0.0047	199.00	0.0089
70.00	0.0282	155.00	0.0074	215.00	0.0014
71.00	0.0167	195.00	0.0022	226.00	0.0047
81.00	0.0255	217.00	0.0024	270.00	0.0024
102.00	0.0189	224.00	0.0069	287.00	0.0032
109.00	0.0104	240.00	0.0052	310.00	0.0012
128.00	0.0296	265.00	0.0093	368.00	0.0135
135.00	0.0148	314.00	0.0037	457.00	0.0005
149.00	0.0275	320.00	0.0069	481.00	0.0038
168.00	0.0107	346.00	0 0034	500.00	0.0018
182.00	0.0204	371.00	0.0061		
193.00	0.0199	386.00	0.0038		
226.00	0.0013	402.00	0.0058		
260.00	0.0159	448.00	0.0006		
500.00	0.0026	500.00	0.0012		

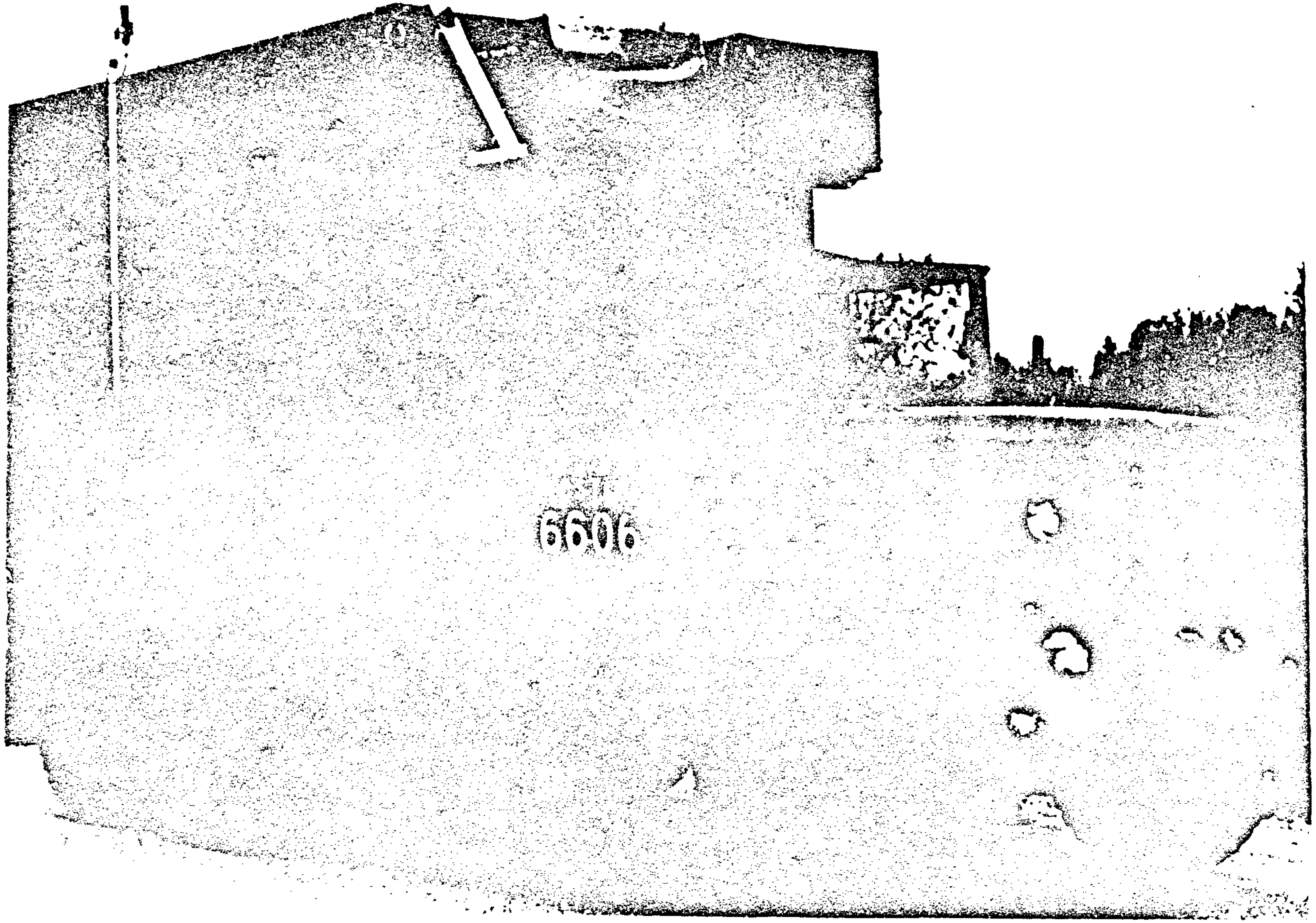

Figure B-1. General view of 18,000 BTU air conditioners, S280 shelter and M35A2C truck.

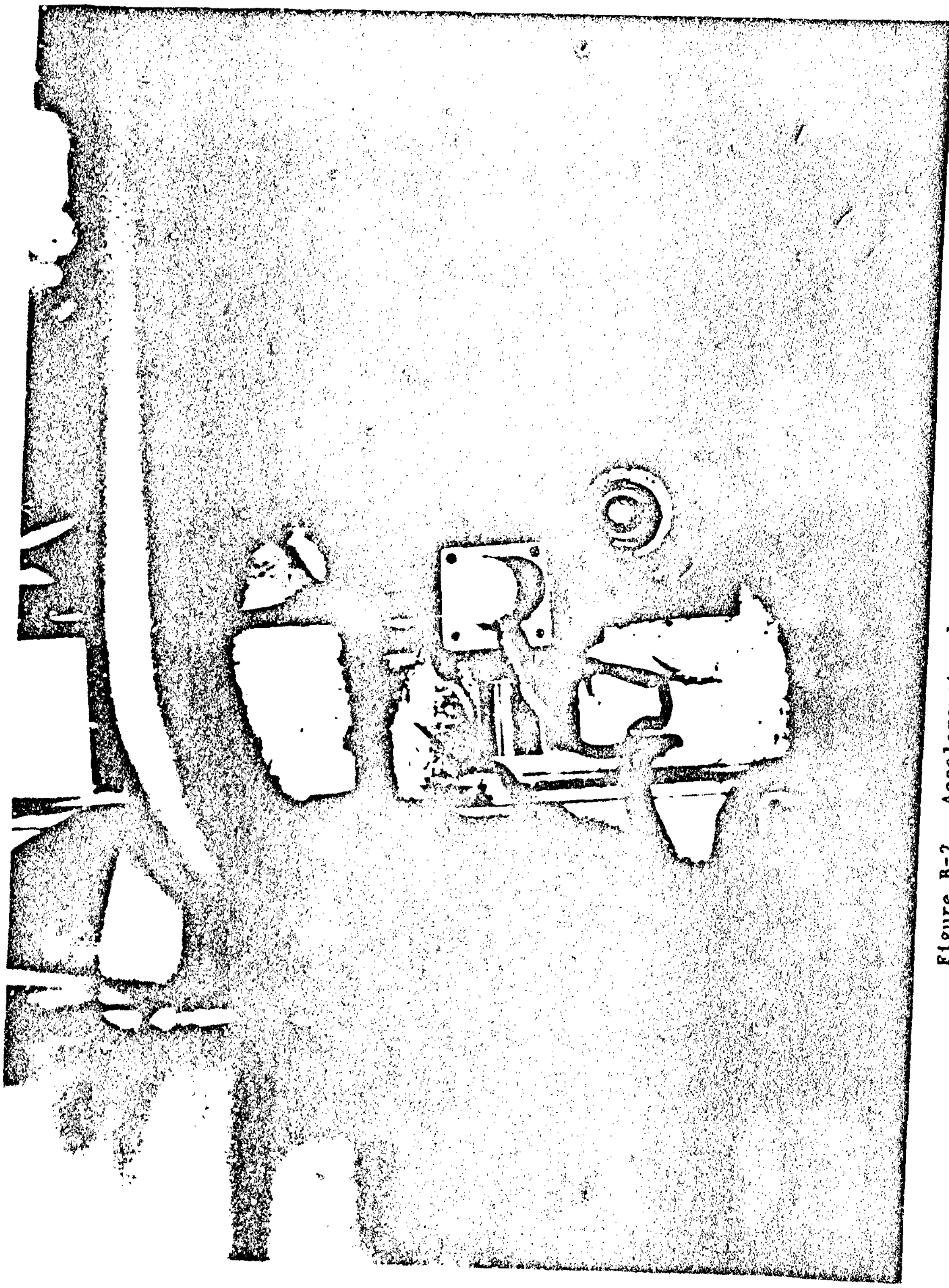

Figure B-2. Accelerometer location at compressor base.

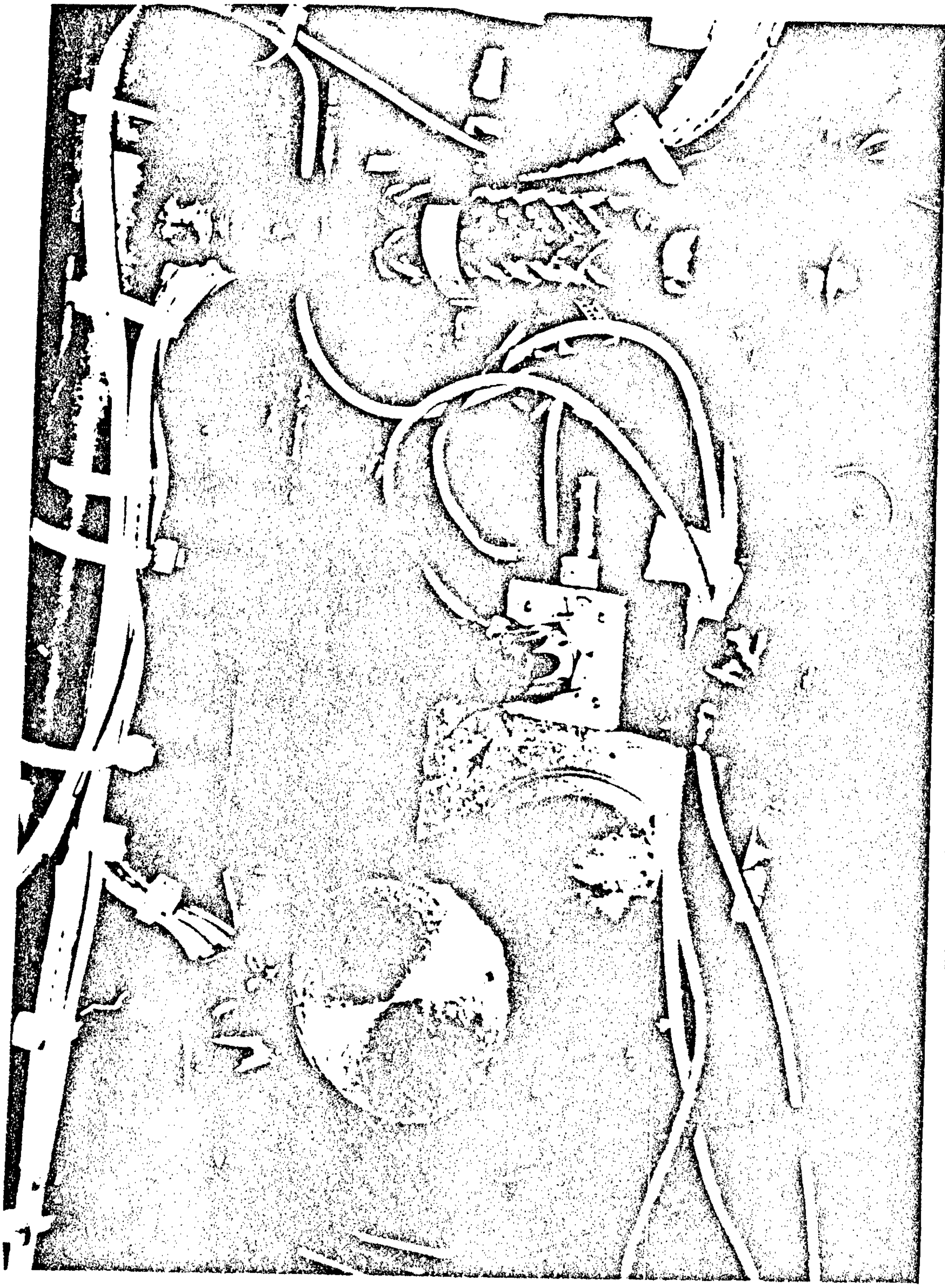

Figure B-3. Accelerometer location at compressor top.

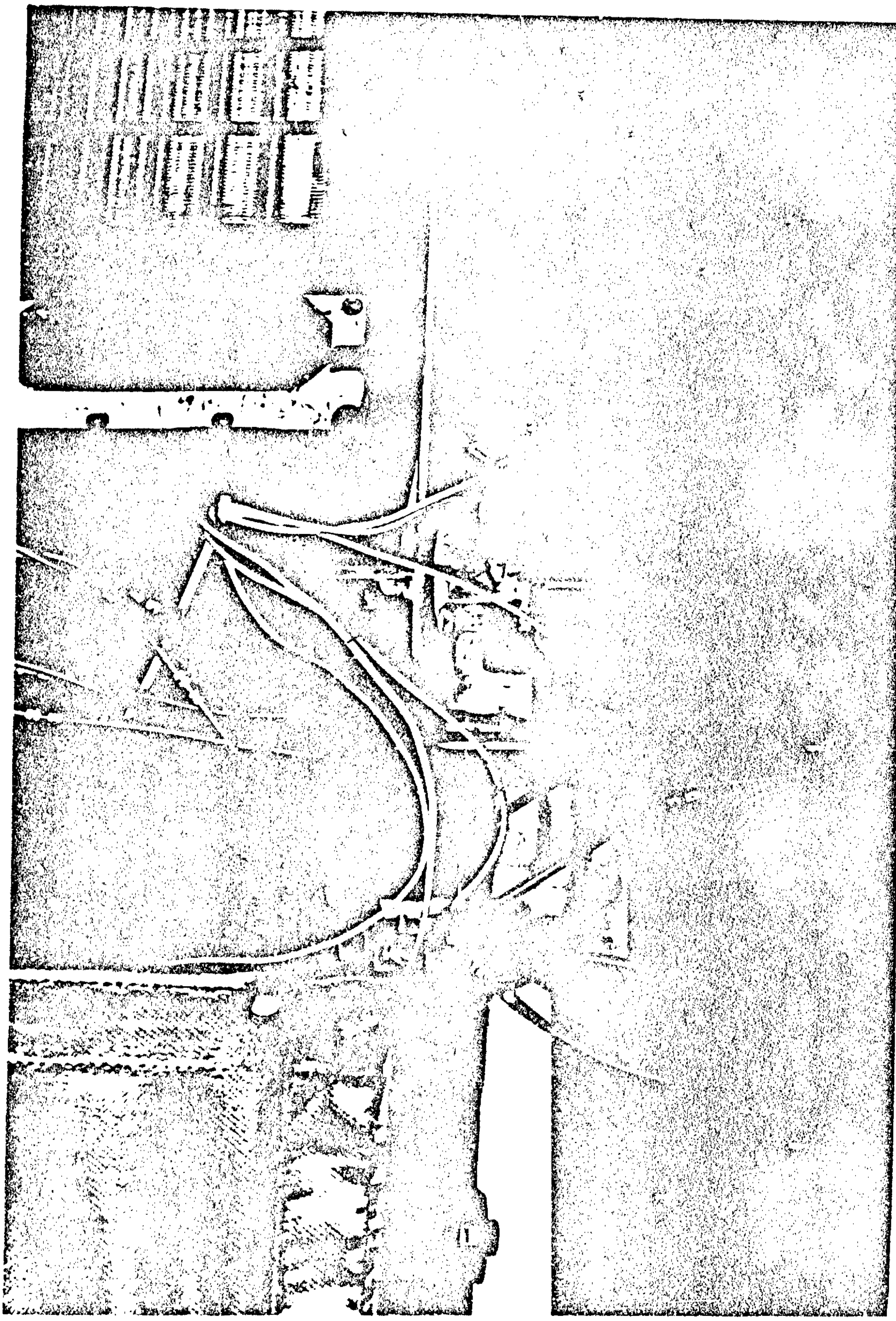

Figure B-4. Accelerometer location at air conditioner mounting bracket.

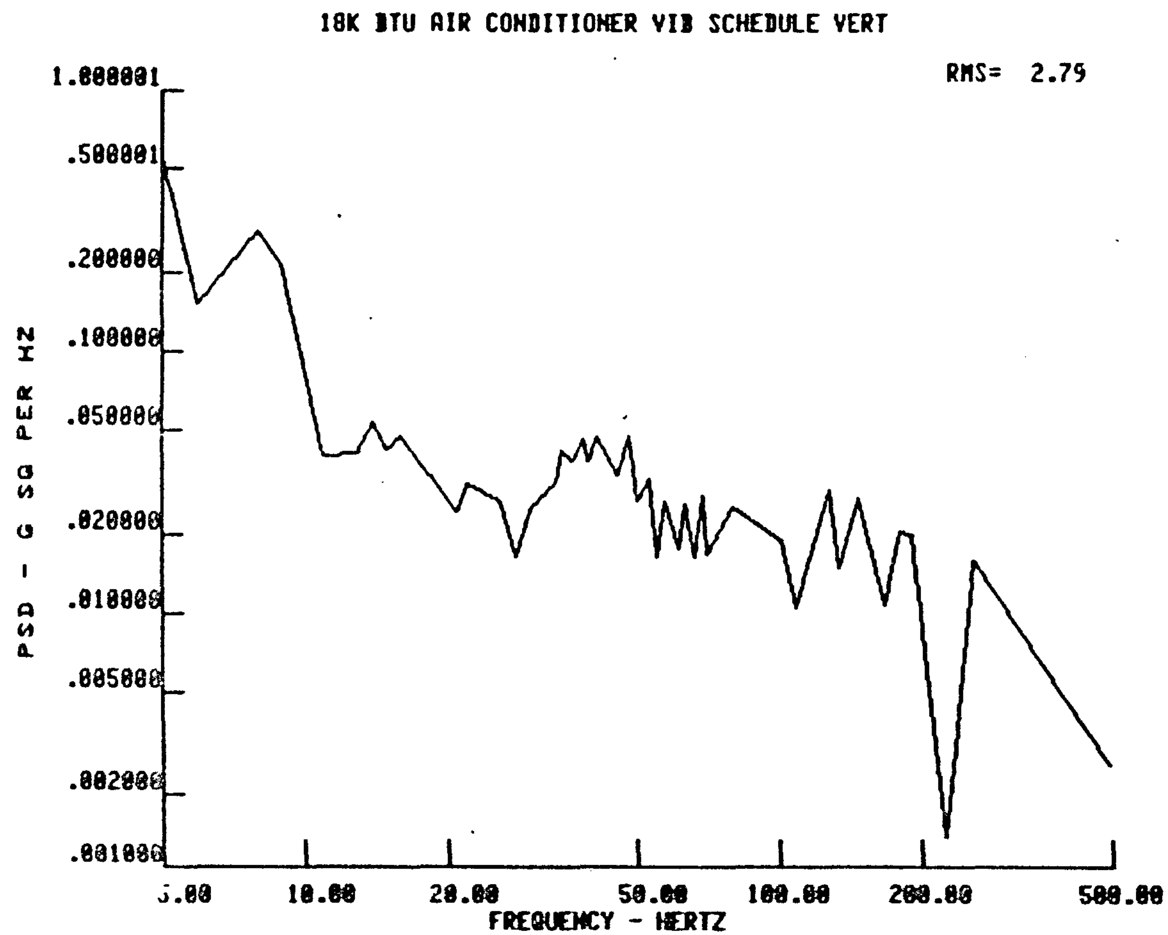

Figure B-5. Vertical laboratory vibration test schedule.

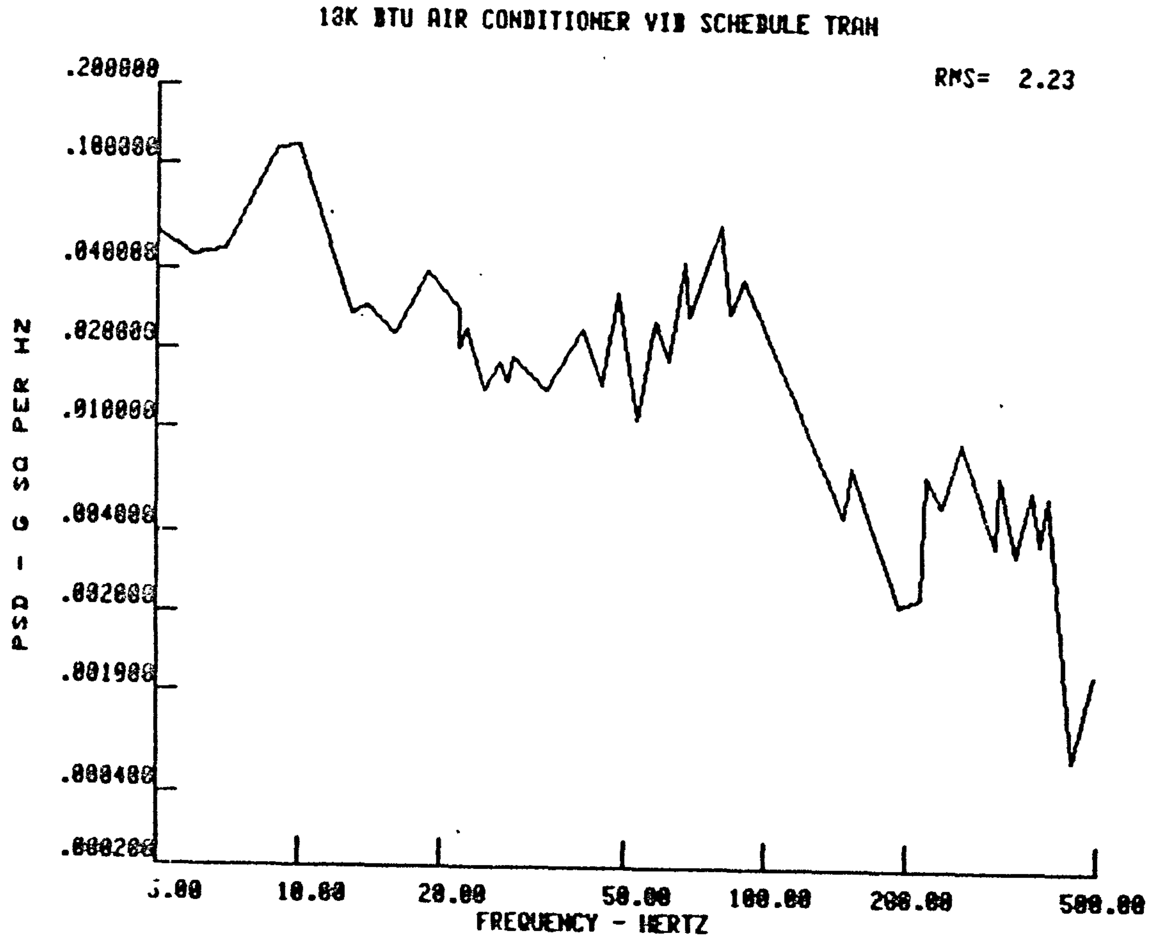

Figure B-6. Transverse laboratory vibration test schedule.

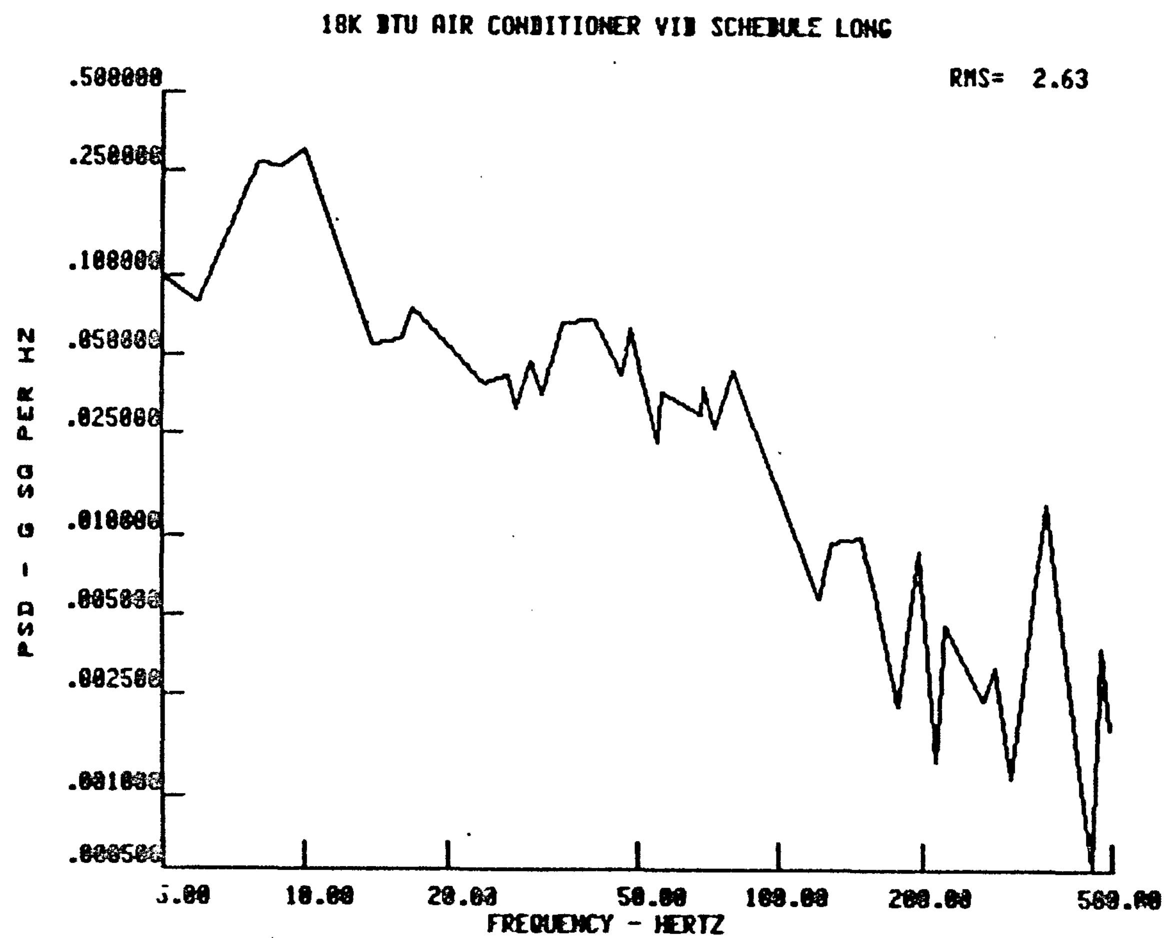

Figure B-7. Longitudinal laboratory vibration test schedule.

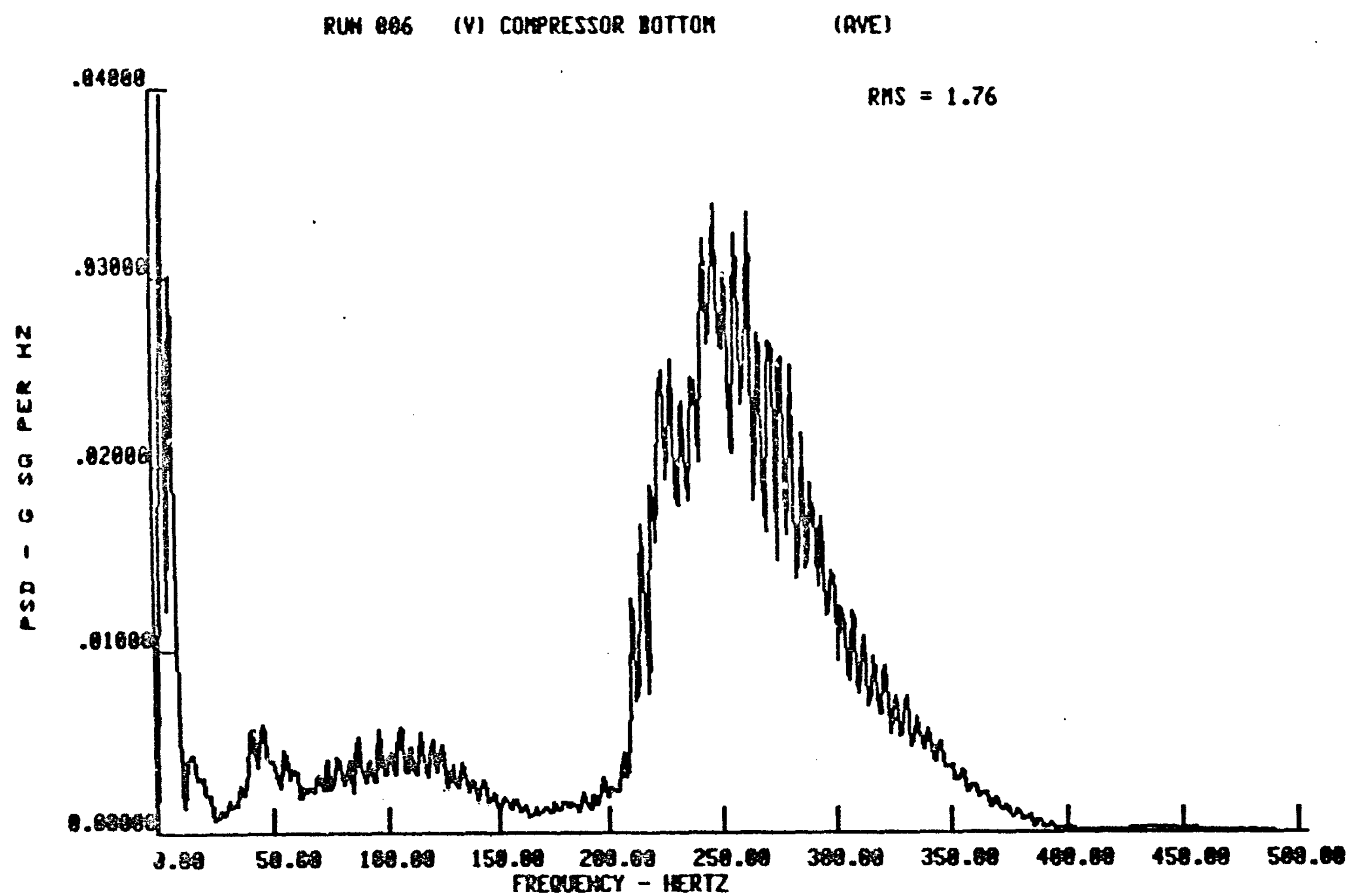

Figure B-8. Power spectral density plot, Belgian block, 32 km/hr.

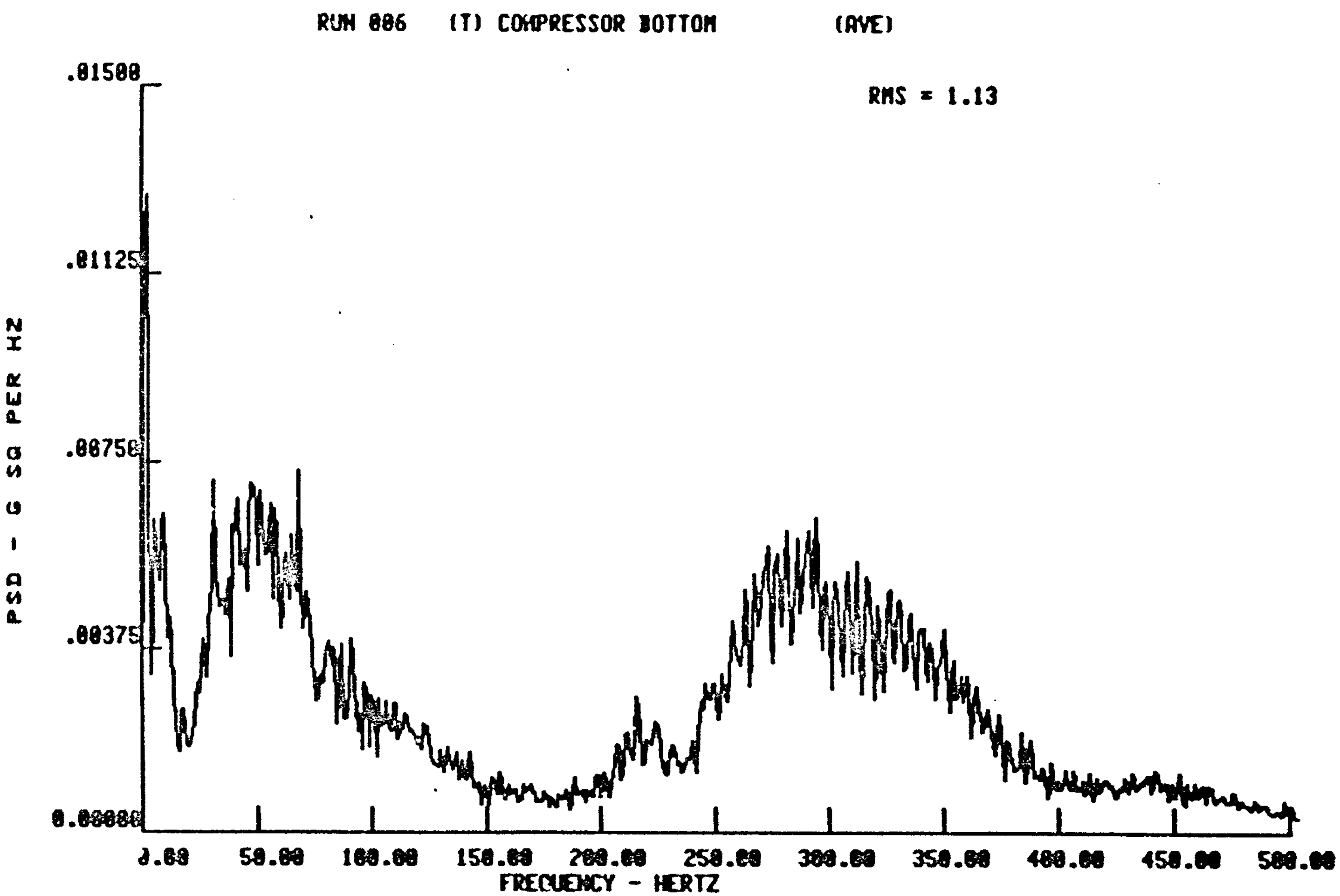

Figure B-9. Power spectral density plot, Belgian block, 32 km/hr.

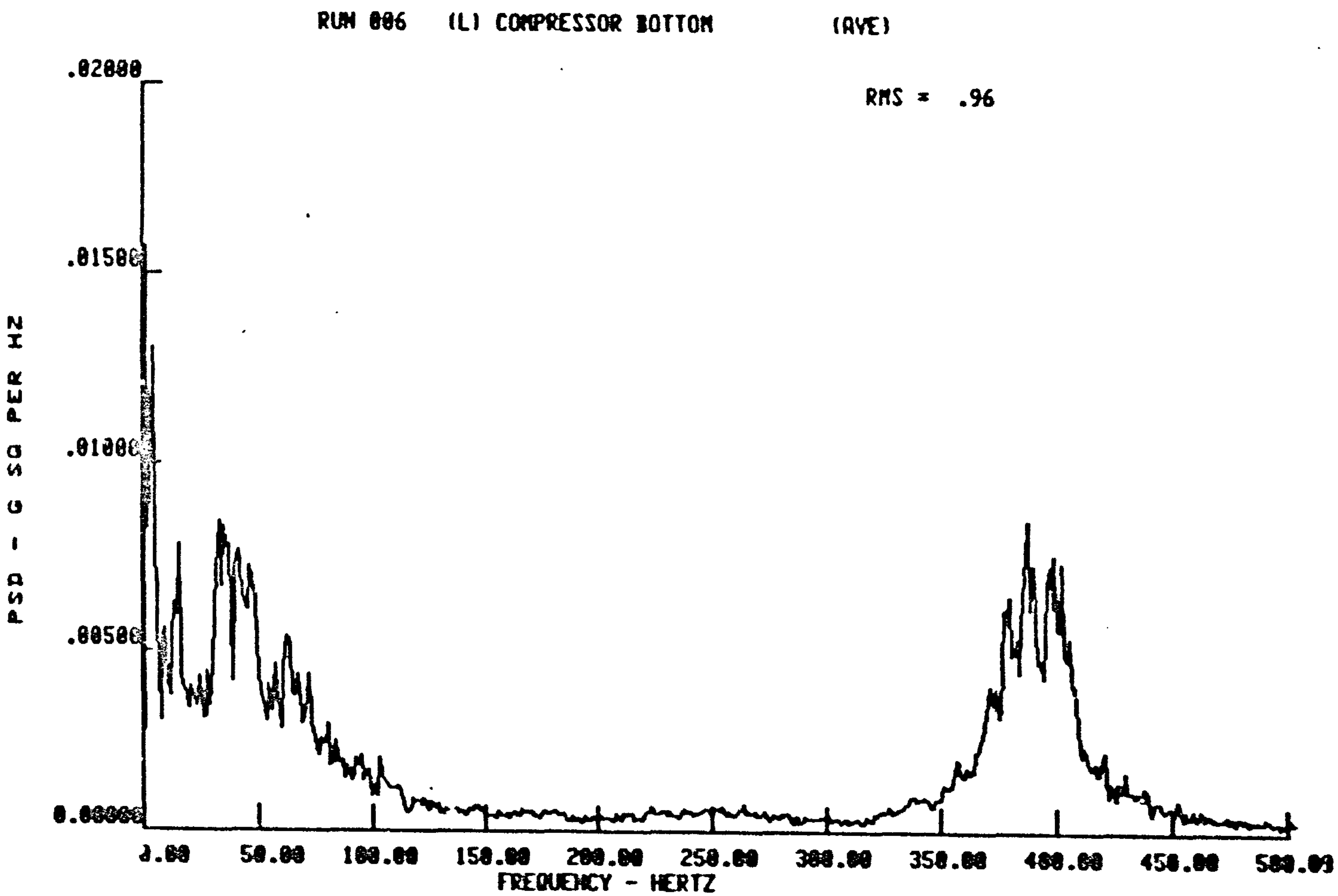

Figure B-10. Power spectral density plot, Belgian block, 32 km/hr.

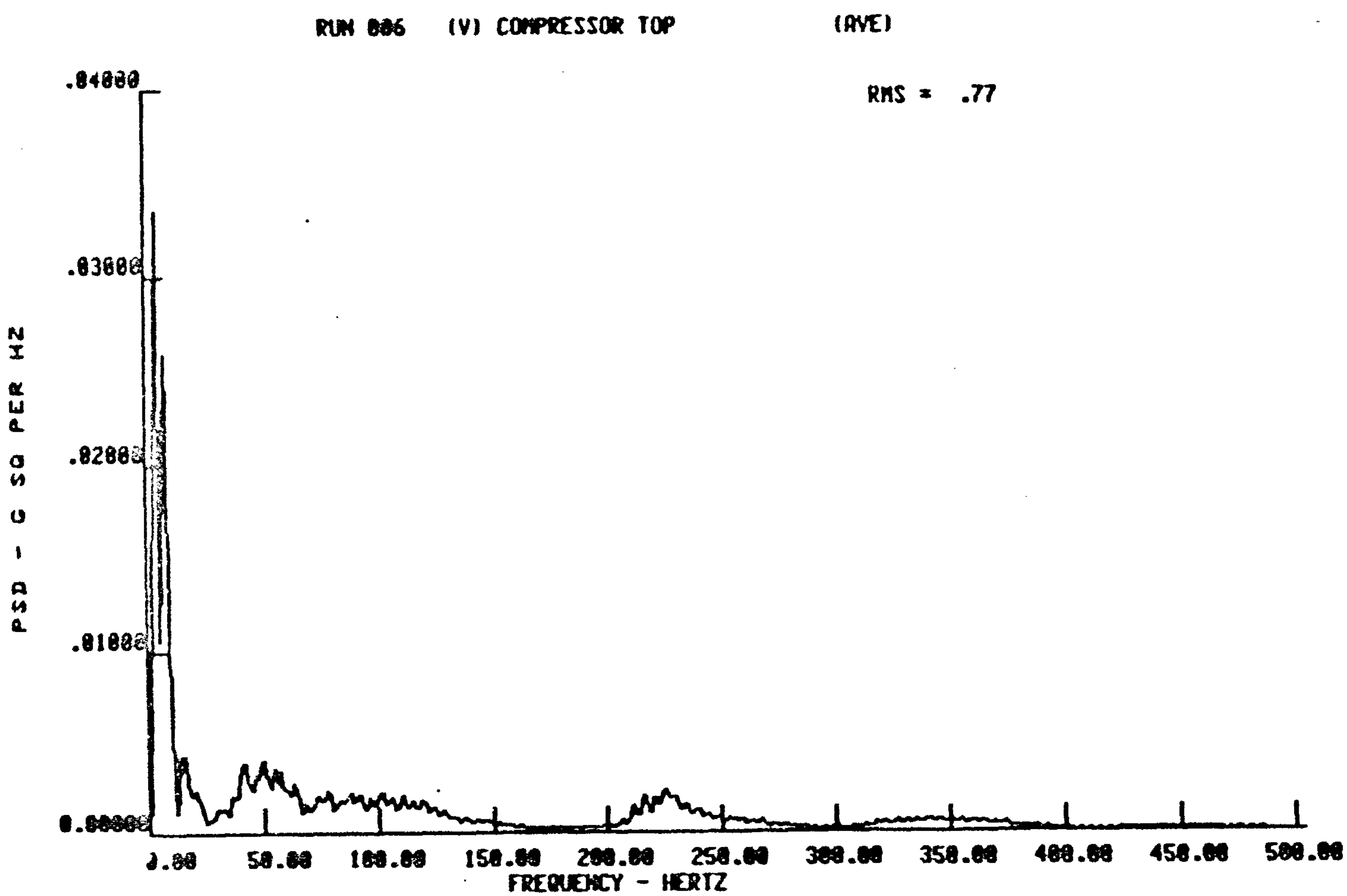

Figure B-11. Power spectral density plot, Belgian block, 32 km/hr.

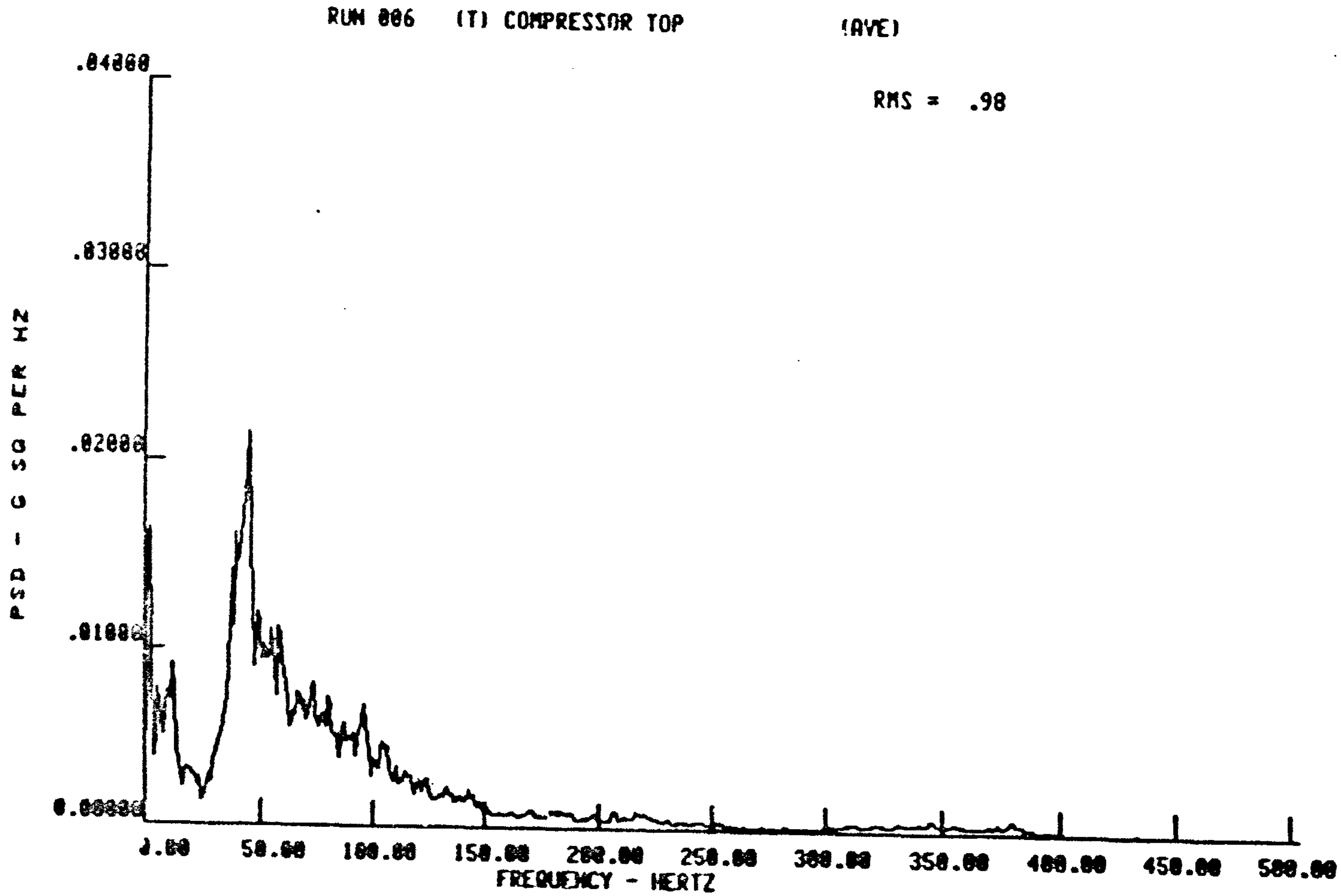

Figure B-12. Power spectral density plot, Belgian block, 32 km/hr.

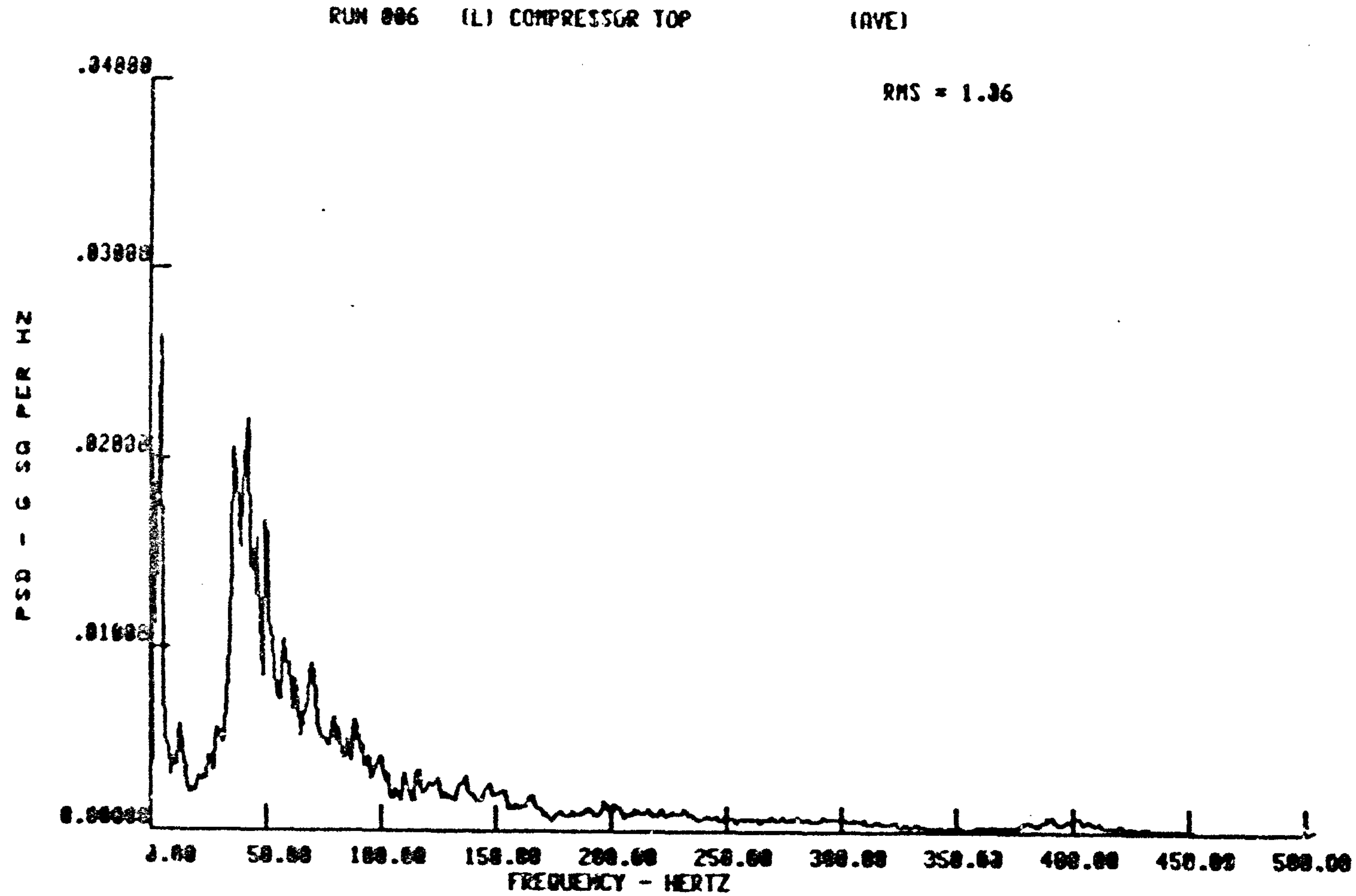

Figure B-13. Power spectral density plot, Belgian block, 32 km/hr.

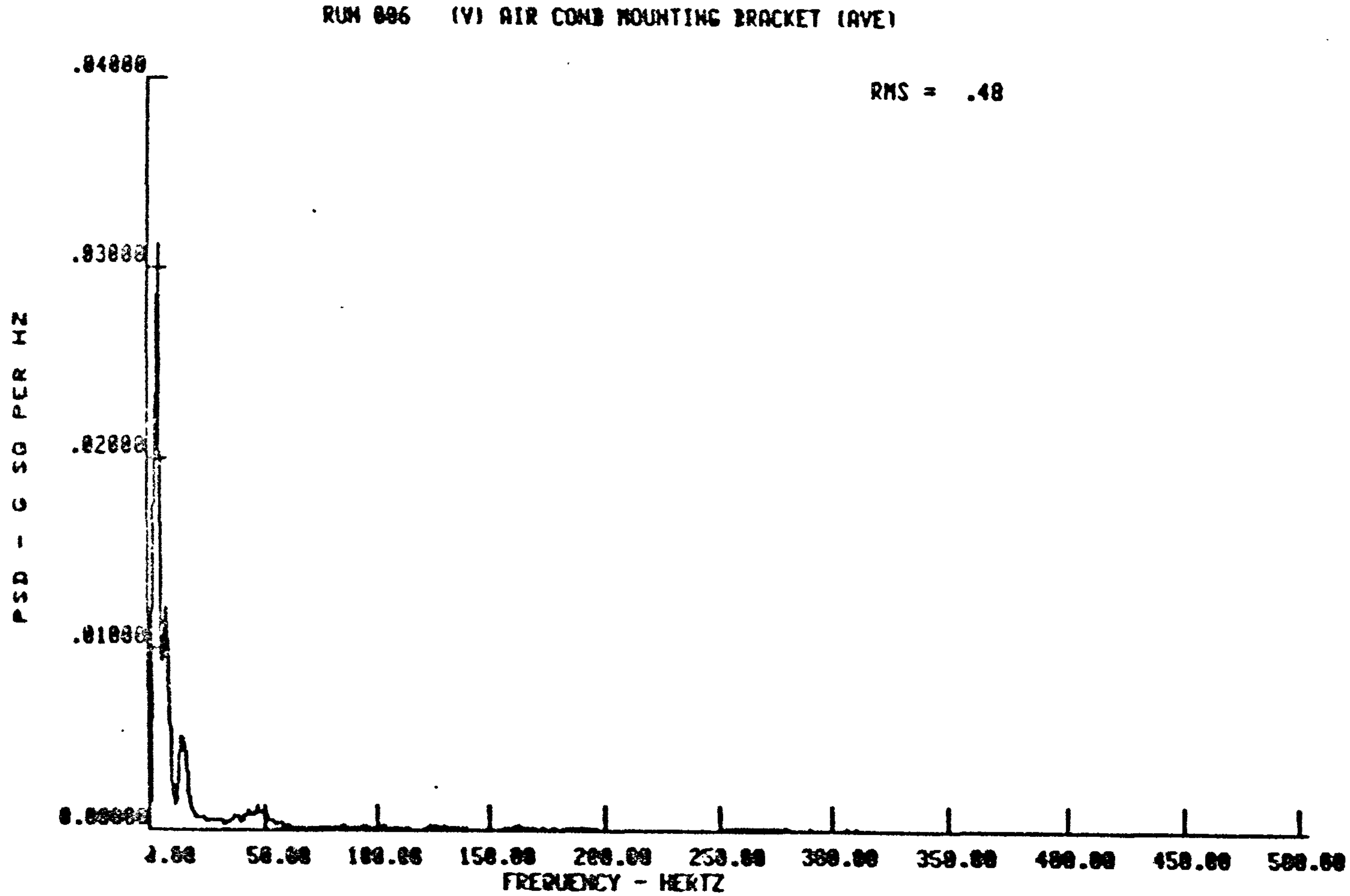

Figure B-14. Power spectral density plot, Belgian block, 32 km/hr.

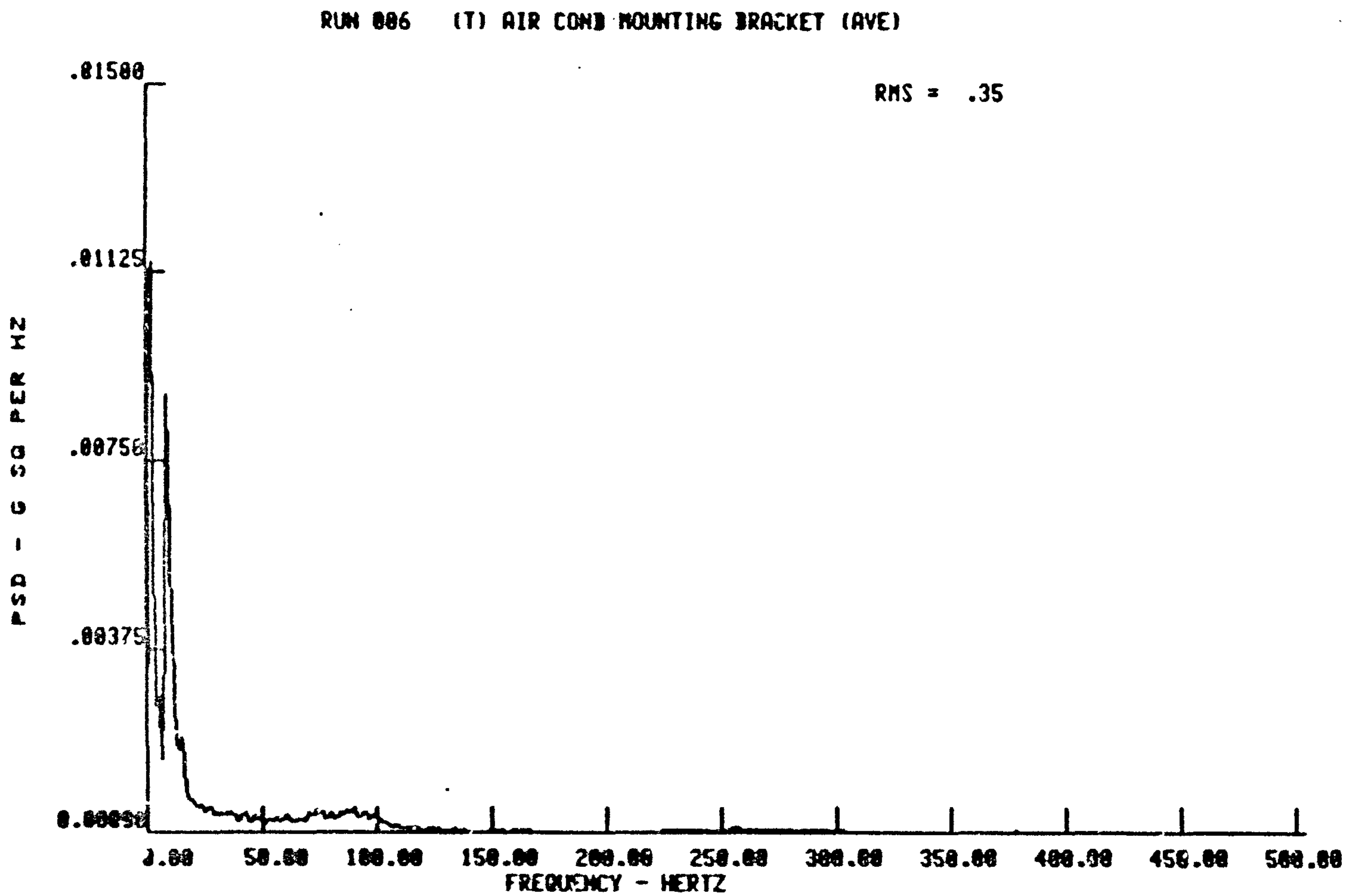

Figure B-15. Power spectral density plot, Belgian block, 32 km/hr.

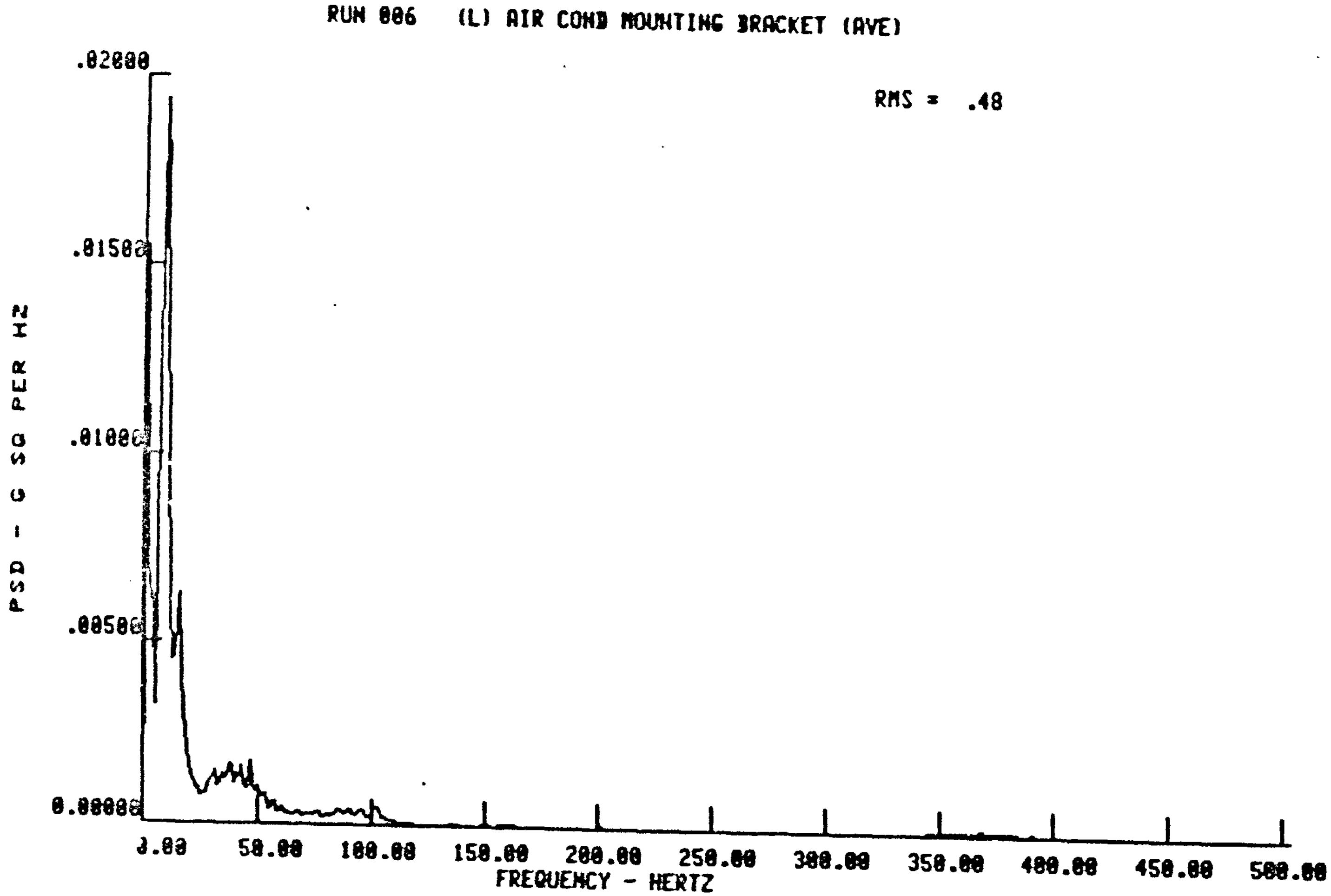

Figure B-16. Power spectral density plot, Belgian block, 32 km/hr.

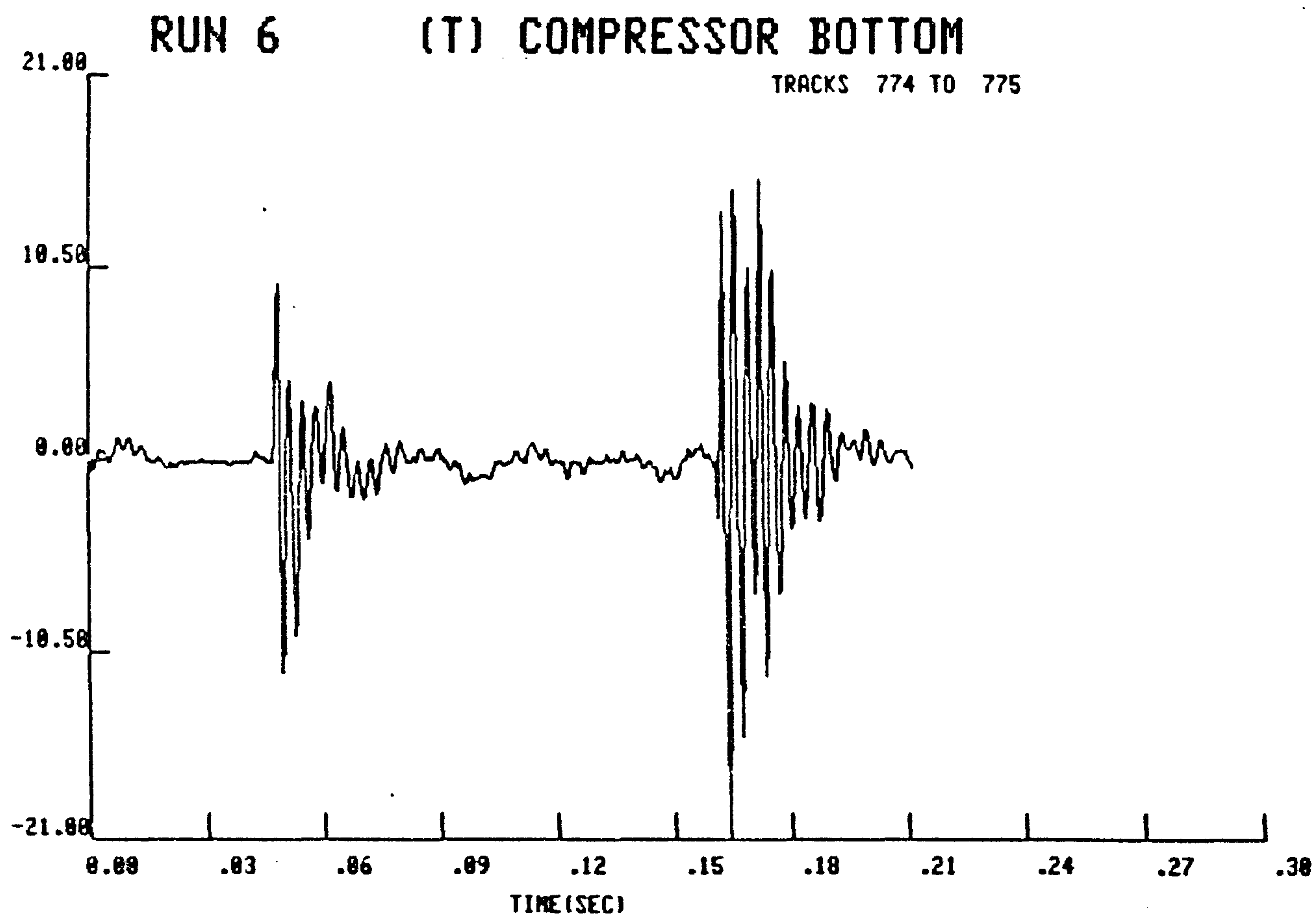

Figure B-17. Time history plot showing shock loading.

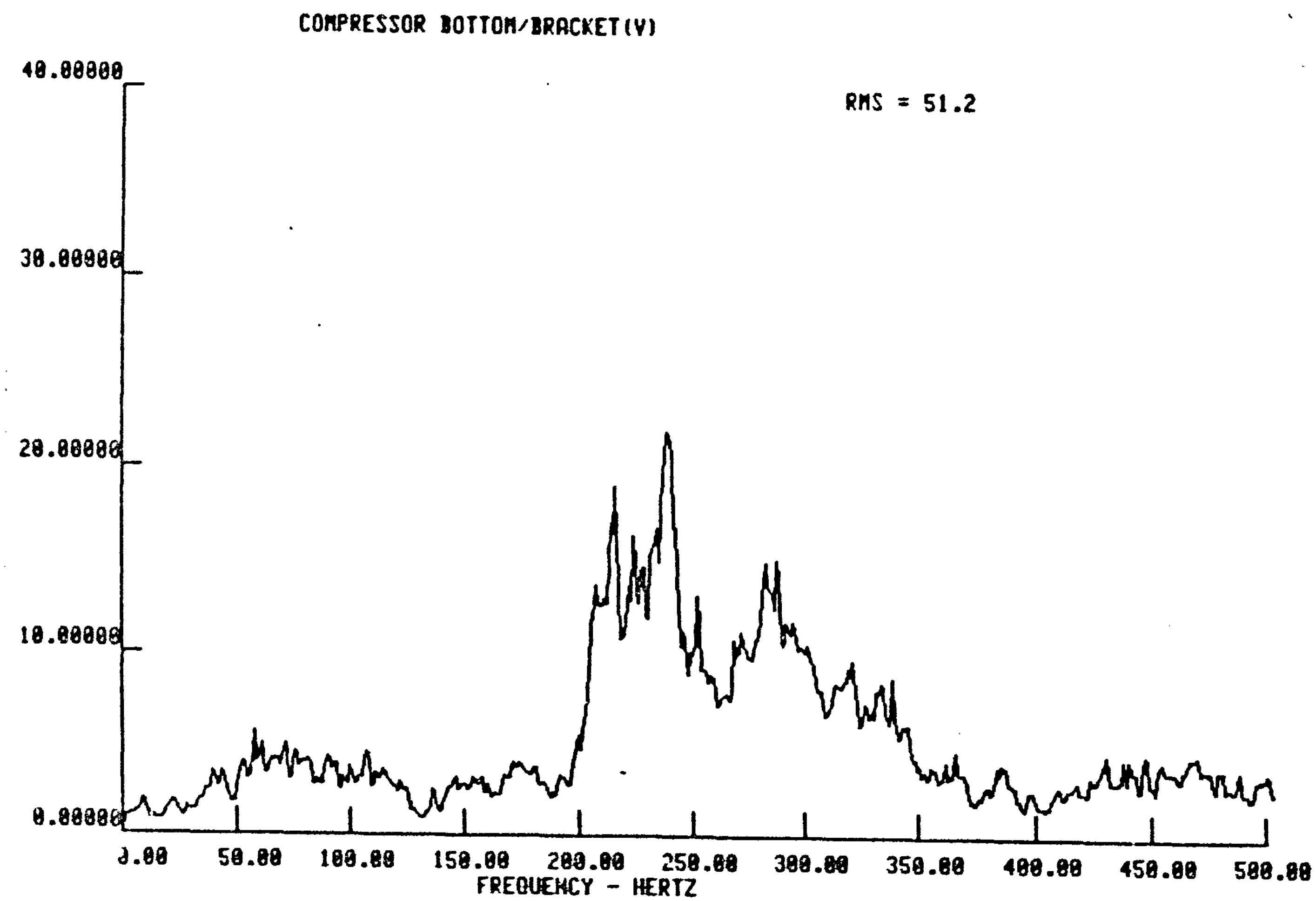

Figure 18. Frequency response function plot, Belgian block, 24 km/hr.

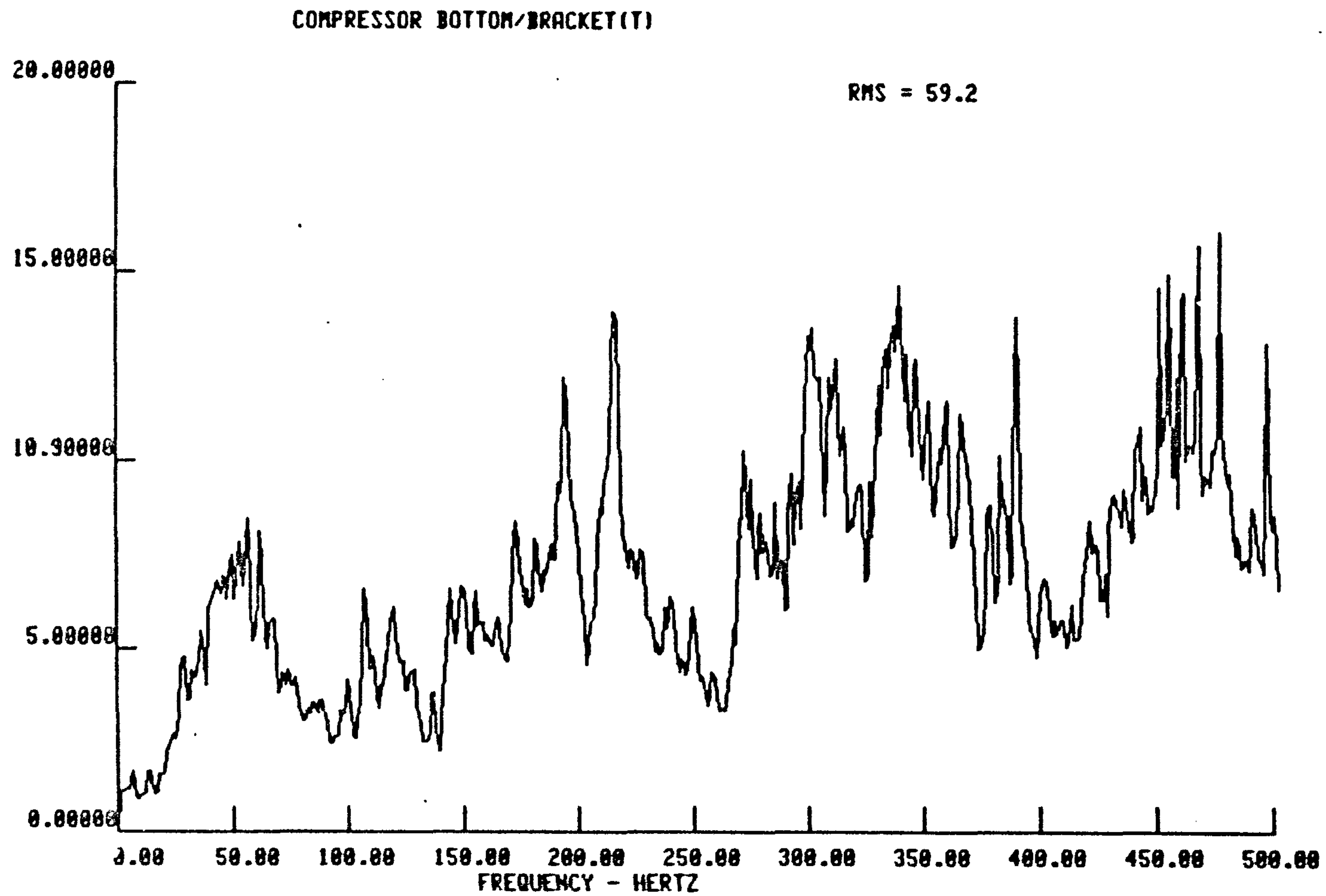

Figure B-19. Frequency response function plot, Belgian block, 24 km/hr.

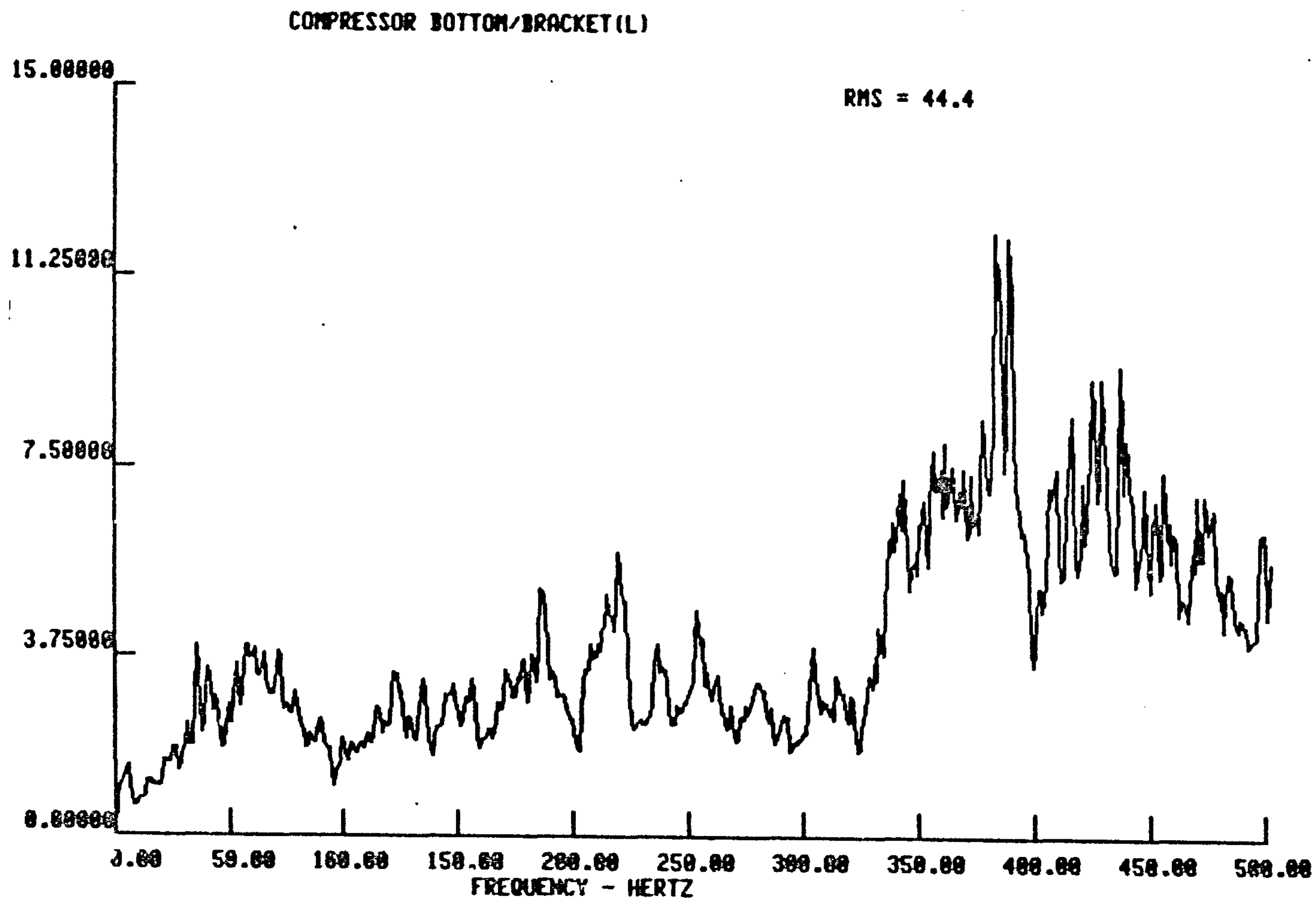

Figure B-20. Frequency response function plot, Belgian block, 24 km/hr.

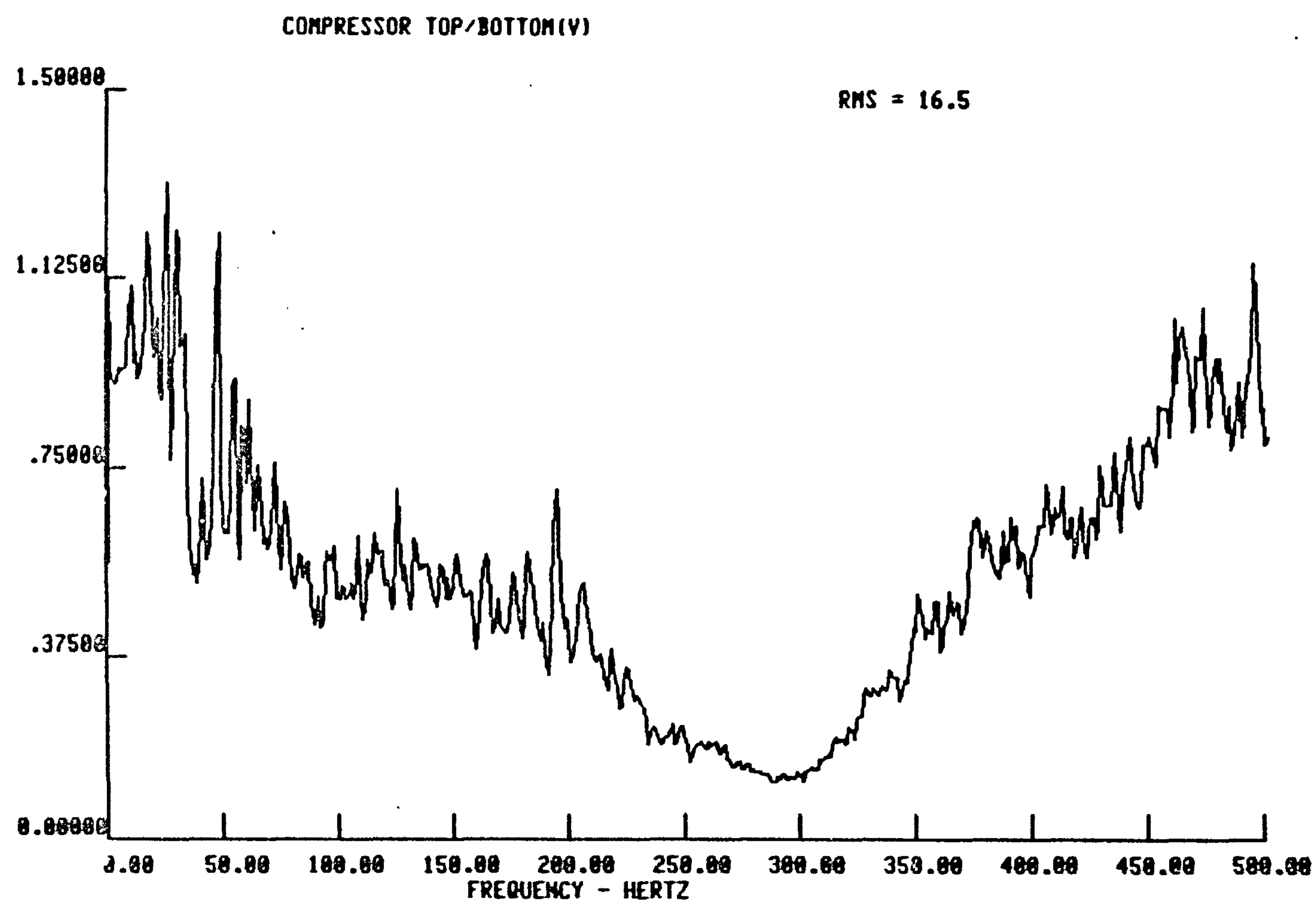

Figure B-21. Frequency response function plot, Belgian block, 24 km/hr.

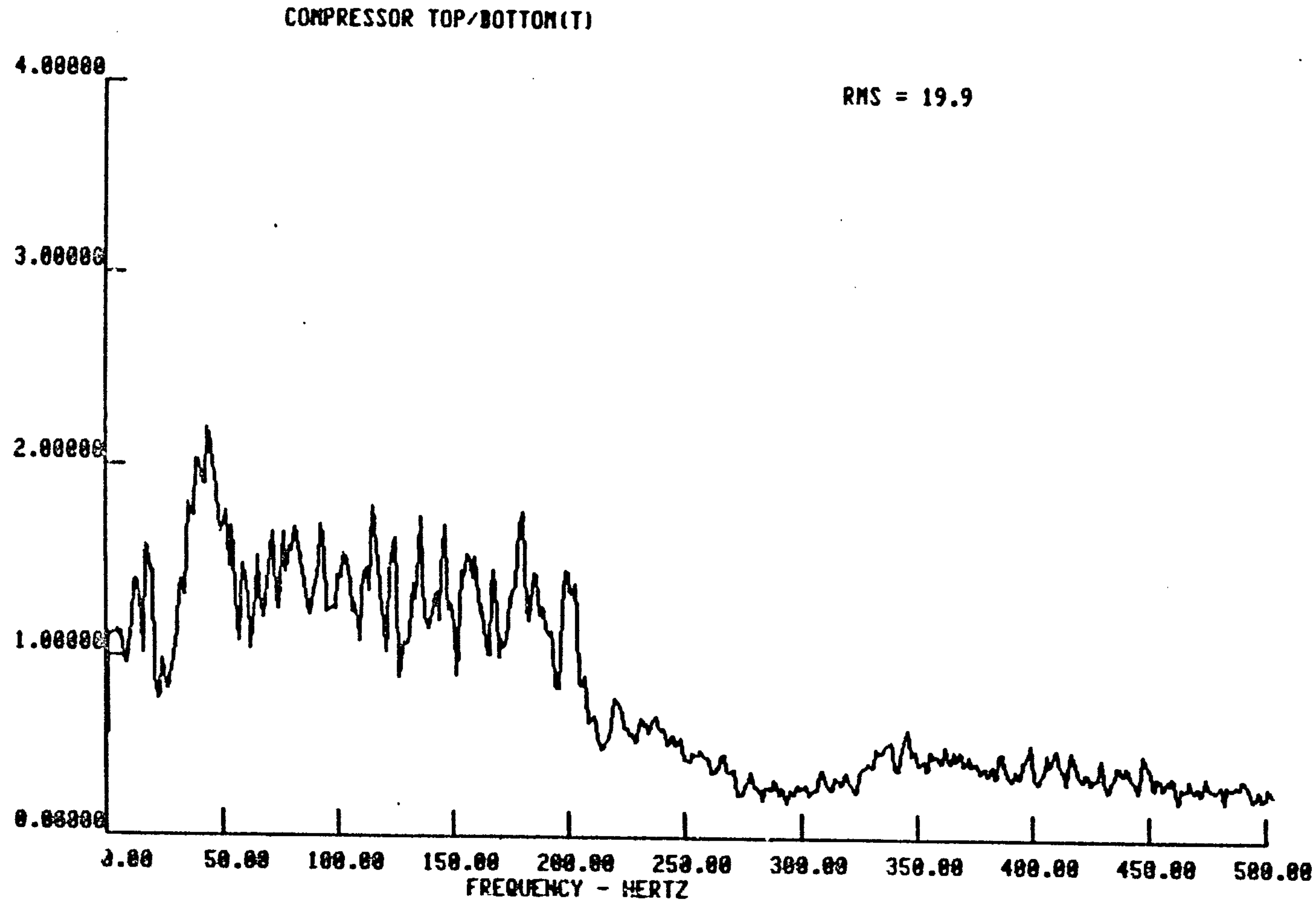

Figure B-22. Frequency response function plot, Belgian block, 24 km/hr.

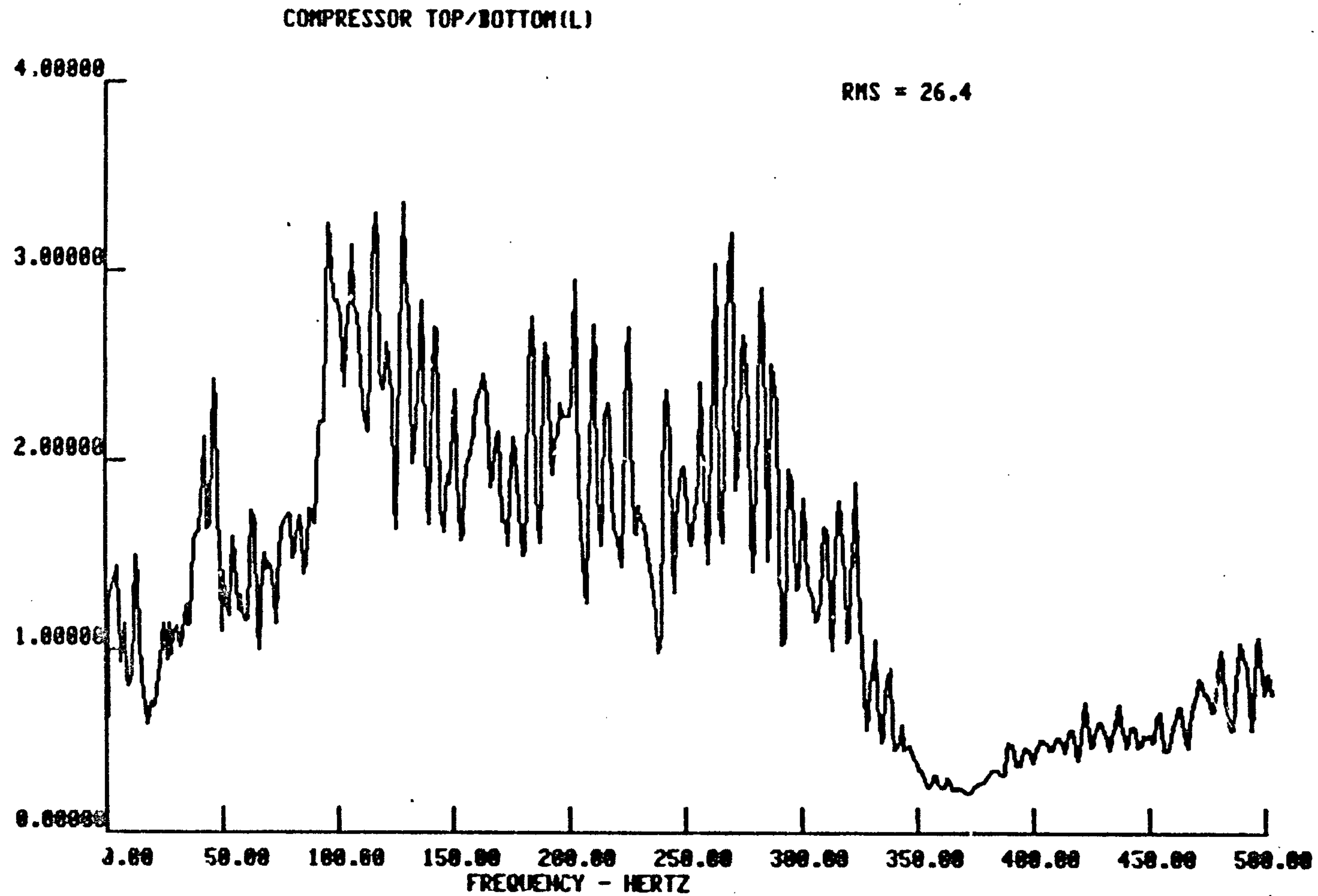

Figure B-23. Frequency response function plot, Belgian block, 24 km/hr.

APPENDIX G. PULSE CODE MODULATION DATA ACQUISITION SYSTEM

APPENDIX G. PULSE CODE MODULATION DATA ACQUISITION SYSTEM

Each of the transducers were connected to a USACSTA signal conditioner which provided excitation, amplification, calibration, and low-pass filtering. The accelerometers were low-pass filtered at 500 Hz. Interchangeable six-pole Butterworth filter pads were installed in the signal conditioner with the filter frequency being the nominal frequency at which the transducer response is attenuated by 3 dB. A block diagram of the PCM data acquisition system is included in Figure G-1.

The output from each channel of the signal conditioner was connected to an EMR Model 372-03 Pulse Code Modulation (PCM) Encoder. The encoder multiplexed the incoming analog signal which was then sampled at 2083.333 samples per second per channel by a sample-and-hold amplifier, digitized by a 10-bit successive approximation analog-to-digital converter, and converted to nonreturn-to-zero-level (NRZ-L) code for transmission. A programmable read-only memory was used for the encoder format control. The encoded PCM data were the inputs to a Conic Model CTL 510 230.9 MHz Transmitter for transmission to the remote data handling facility. The signal conditioner, encoder and transmitter were mounted in the cab of the prime mover. The transmitted NRZ-L code was received by a Scientific Atlanta Series 420S Receiver and recorded on a Honeywell Model 1-1 PCM Tape Recorder along with voice annotation of the individual test runs and IRIG-B time code. Simultaneously, the PCM pulse train was passed to a Loral Instrumentation ADS-100 PCM Decommutator.

The ADS-100 system consists of several modules. The input buffer and bit synchronizer modules recovered the serial pulse train from the data link noise and disturbances. The frame synchronizer and data distributor modules demultiplexed the serial pulse train into 16-bit words. A parallel input module was used to input digital IRIG-B time code into the ADS-100. The compressor and direct memory access (DMA) modules performed data sorting and transfer to the host computer, an HP21MX-E series minicomputer. The data were temporarily stored on the HP system disk and later transferred to digital tape to provide a permanent storage medium. The ADS-100 system was independent of host control; however, software residing on the minicomputer controlled the hand shaking between the ADS-100 and the HP21MX-E during data acquisition.

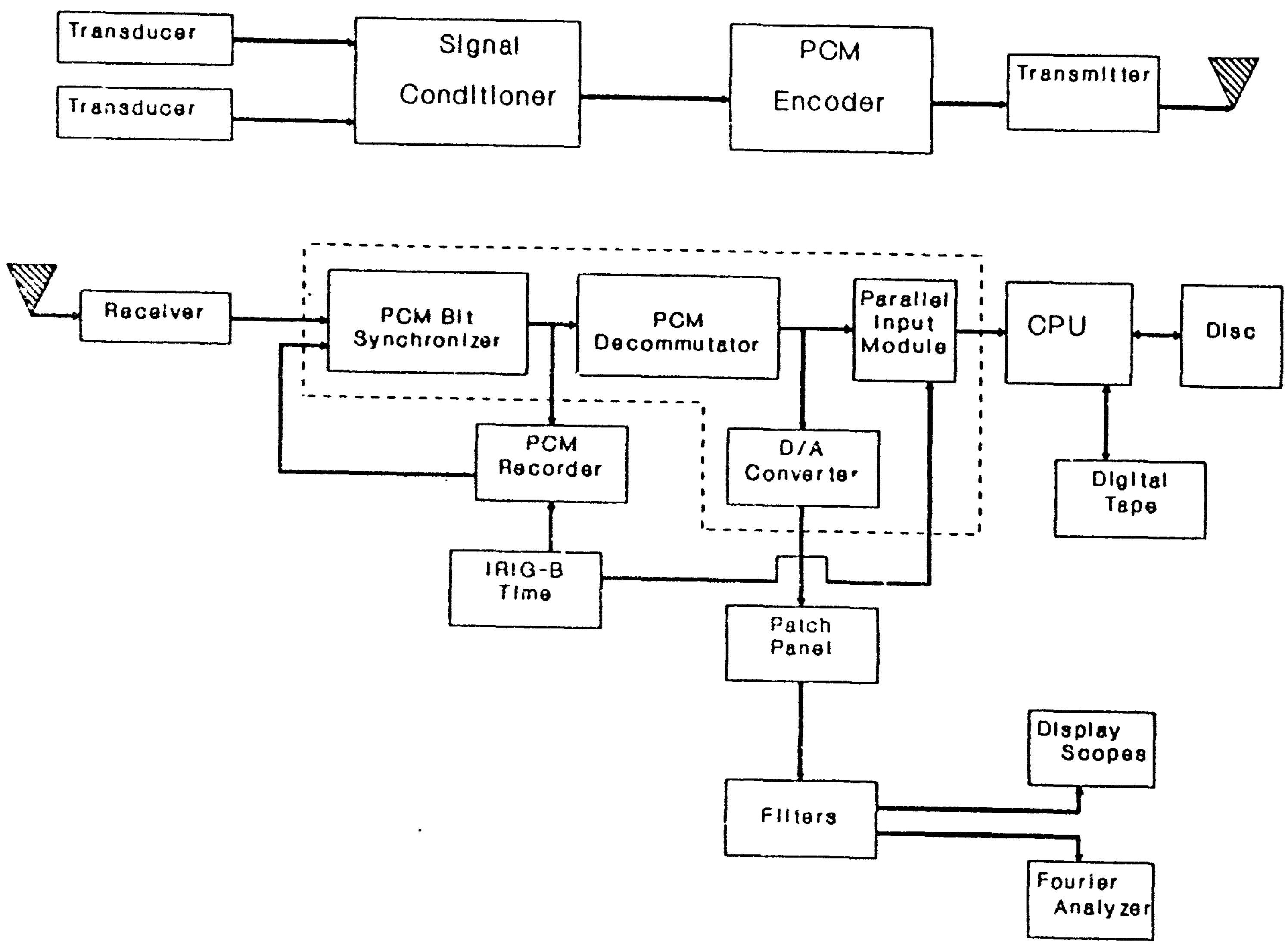

Figure G-1. Block diagram of PCM data acquisition system.

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APPENDIX H. DATA VERIFICATION

The data verification that was performed consisted of searching the individual channels for frame errors, wild points and DC shifts. A frame error occurs whenever the PCM stream is interrupted, which induces artificial high-level spikes into the data stream. Data approaching full scale values, in addition to frame errors, are flagged by the frame error check program, because the program defines a frame error as being any data value which is greater than 98 percent of full scale. The same program checks the data for wild points and DC shifts. A wild point is just like a frame error except its amplitude is smaller and does not approach full scale. The program defines a wild point as a positive or negative change of more than 100 resolution steps from the previous point. A DC shift occurs whenever the data average changes rather abruptly and then remains constant after the change. The program defines a DC shift as a shift of more than 25 resolution steps from the previous average, with the average being based on approximately 1/6 second. These errors are obvious when plotted in the form of a time history, but the quantity of data collected is such that viewing it all as a time history is impossible. For this reason, the frame error check program is utilized, and the locations of all such errors on the system disc are printed out for a permanent record.

As a further step in the data verification process, acceleration amplitude distribution data were compiled by histogramming the data into a 512-bin field and calculating cumulative distributions. Table H-1 shows sample acceleration amplitude distribution data. The average value for each channel was removed to account for DC offsets in the instrumentation. The percentile columns represent the percentage of time the data was in that particular range. For example, 99.9 percent of the time, the data value for channel 1 was less than 1.02 but greater than -0.71. The units for the accelerometer amplitude distribution data are g's.

TABLE H-1. SAMPLE AMPLITUDE DISTRIBUTION DATA

Run Number, Test Course, Speed, etc.

Description	rms	+Peak	-Peak	+99.9%	-99.9%	+99%	-99%	+90%	-90%
Channel 1	0.28	1.25	-1.05	1.02	-0.71	0.68	-0.55	0.37	-0.36
Channel 2	0.31	1.32	-1.02	1.08	-0.78	0.71	-0.62	0.39	-0.42
Channel 3	0.23	1.34	-0.83	0.96	-0.65	0.66	-0.50	0.29	-0.27
Channel 4	0.22	1.22	-0.82	0.94	-0.58	0.62	-0.42	0.26	-0.26
Channel 5	0.24	1.04	-1.02	0.85	-0.64	0.59	-0.49	0.33	-0.31
Channel 6	0.36	1.50	-1.57	1.19	-0.92	0.81	-0.73	0.46	-0.46
Channel 7	0.39	1.66	-1.37	1.30	-0.97	0.86	-0.81	0.50	-0.49
Channel 8	0.21	1.27	-0.83	0.95	-0.60	0.64	-0.44	0.24	-0.24

The program which performs the amplitude distribution analysis and creates tables such as the one above performs a number of data validity tests for each channel and provides messages such as:

a. Channel inactive.

b. Data one-sided.

c. Data noisy.

d. Data clipped.

e. Large rms value.

f. Large DC offset.

g. No data spread.

h. Shock present in data.

If a large number of samples are processed and if the dynamic range of the data is small, a bin overflow can occur. This happens when more than 32,767 samples occur in any one bin and usually appears as an inactive channel (rms set to 0.0). Although the amplitude distribution program is not foolproof, and the rules which determine data validity are somewhat arbitrary, the program provides a very useful tool for "quick look" verification and analysis.

The test data were then checked for stationarity or time invariance. Data are collected and analyzed for short periods of time wherein seasonal differences in performance and long-term vehicle degradation have no influence. Hence, a single time history record should adequately define the distribution of the data. Multiple sample records are used in all steady-state analyses under the assumption that the data are stationary. This provides a broader, more dependable sample population and statistical base for analyses such as acceleration amplitude distributions and acceleration power spectral densities. The test for stationarity is based on the following assumptions:

a. The data to be analyzed are not of transient nature (e.g., single mechanical shock).

b. The sample record taken will reveal the non-stationary character of the random process in question.

c. The sample record is very long relative to the lowest frequency component in the data.

d. Any nonstationarity of significance will be revealed by changes in the rms value of the data with time.

Because the objective is to measure short term rapidly changing phenomena rather than seasonal differences or vehicle degradation, it is assumed that a, b, and c, for this purpose, are true. A nonparametric statistical test, called a run test, is used to check assumption d. The run test consists of computing the rms value for a series of subrecords from the time history (e.g., 30 rms values over 1-second intervals for a 30-second record), finding the median value of the computed rms values, and counting the number of runs (crossings above and below the median value) in the set of rms values. The number of runs is then compared at the 5-percent level of significance to that for theoretical Gaussian distribution, and the hypothesis that the data are stationary is either accepted or rejected. Printouts list the average value, maximum absolute value, and rms value for the data in the same blocks in which the PSDs will be computed so inconsistent blocks of data can also be deleted from the analyses.

The statistical moments, or weighted excursions about the mean, were also computed as part of the verification process. Only the first four moments are generally of interest and are described below:

$$M_1 = 1/n \Sigma x_i = x$$

$$M_2 = 1/n \Sigma (x_i - x)^2$$

$$M_3 = 1/n \Sigma (x_i - x)^3$$

$$M_4 = 1/n \Sigma (x_i - x)^4$$

The first two moments are commonly referred to as the mean and variance, while the third and fourth moments are sometimes called the skewness and kurtosis of the distribution. More often, a normalized version of the skewness and kurtosis are computed as shown below:

$$\text{Skewness} = \frac{M_3}{(M_2)^{3/2}}$$

$$\text{Kurtosis} = \frac{M_4}{(M_2)^2}$$

A normal distribution has a skewness of zero (as do all symmetric distributions) and a kurtosis of 3. If the kurtosis of the data set is higher than this, it is an indication that there is considerable data out at high amplitude values. Because the kurtosis value is based on the fourth power of the distance from the mean, it is extremely sensitive to wild points, even in small quantities. This value has proven to be an effective screen against abnormal data.

APPENDIX I. VIBRATION DATA ANALYSIS

The acceleration power spectral density was computed by dividing the time domain data into successive blocks of 2048 points, converting to the frequency domain using the Fast Fourier Transform (FFT), multiplying this result by its complex conjugate, and linearly accumulating (averaging) these results over the entire data run. The number of linear averages applied was dependent upon the amount of valid data available for a particular data run. For a linearly averaged process, the number of statistical degrees-of-freedom is equal to twice the number of averages used. The amount of averaging (degrees-of-freedom) determines the degree of confidence that the value measured is a true representation of the actual physical phenomena. An error band, based on the number of averages, can be computed for various confidence levels from the chi squared/degrees-of-freedom distribution. When the FFT algorithm is used, an assumption is made that the time record being transformed (data block) is repeated throughout time. If the time record contains an integer number of cycles within the data block, the assumption is valid and the waveform is said to be periodic within the time record. In most cases, the data are not periodic within the record which causes a truncation of the signal at the end of the data block. Since the assumption is one of a repeated waveform, the analysis process assumes that the truncation is repeated throughout the entire data record. The effect in the time domain is an apparent discontinuity in the representation of the data signal. In the frequency domain, the discontinuity appears as side lobes or additional frequency components and is known as leakage. A time domain truncation technique known as windowing is employed to reduce the leakage. A Hanning window was employed for this analysis.

The dynamic characteristics of a physical system can be described by a frequency response function, H(f), which relates system response to a given input by:

$$Y(f) = H(f)\,X(f)$$

where

Y(f) = Fourier transform of system response
H(f) = frequency response function
x(f) = Fourier transform of system input.

Since both Y(f) and X(f) can be complex values (real and imaginary components), H(f) can be a complex value. In practical terms, the relationship between the real and imaginary components at any frequency are used to find the phase relationship at that frequency.

The frequency response function is computed as the ratio of the cross power spectrum, G_{yx}, divided by the input auto power spectrum, G_{xx}. The cross power spectrum is defined as the Fourier transform of Y(t), Y(f), multiplied by the complex conjugate of the Fourier transform of x(t), X*(f).

$$H(f) = G_{yx}(f)/G_{xx}(f)$$

where

$H(f)$ - frequency response function
$G_{yx}(f)$ - cross power spectrum between input and response
$G_{xx}(f)$ - auto power spectrum (PSD) of input.

Since the frequency response function contains real and imaginary values, it can be difficult to use in normal form. For this analysis, the polar form (magnitude and phase) was calculated and presented (magnitude only). The polar form was calculated from:

$$H(f) = (H_r(f)^2 + H_i(f)^2)^{1/2}$$

where

$H(f)$ - magnitude of frequency response function
$H_r(f)$ - real part of frequency function
$H_i(f)$ - imaginary part of frequency response function.

When calculating the frequency response function, extraneous inputs and system nonlinearities can cause errors in the computation. The coherence function is a procedure used to check the validity of the frequency response function and thus can be used to check causality (input a causes response b) between two signals. The value of the coherence function is a dimensionless number between zero and one. A zero value indicates that the system may have extraneous inputs or may be highly nonlinear. A value of 1 indicates complete coherence between input and output (linear system, only one input). The coherence function was calculated as follows:

$$C^2_{xy}(f) = G_{yx}(f)^2/(G_{xx}(f)\ G_{yy}(f))$$

where

$C^2_{xy}(f)$ - coherence function
$G_{yx}(f)$ - magnitude of cross power spectrum
$G_{xx}(f)$ - input auto power spectrum
$G_{yy}(f)$ - response auto power spectrum.

The computational techniques used to produce the cross power spectrum, input auto power spectrum and response power spectrum (block size, averaging, windowing, etc.) were the same as for the PSD computations discussed previously.

These functions were not computed directly; however, the program *dvpsd* was used to compute the transmissibility function described here as:

$T_{xy}(f)$ - transmissibility function
$G_{xx}(f)$ - input auto power spectrum
$G_{yy}(f)$ - response auto power spectrum.

It can be shown that the transmissibility function is equal to the square of the magnitude of the frequency response function if the coherence function has a value of one and is larger than that in all other cases. Thus, a pseudo-transfer function was calculated by determining the transmissibility and taking the square root of the result. This pseudo-transfer function represents an upper bound of the actual frequency response function.

APPENDIX J. DEVELOPMENT OF LABORATORY VIBRATION TEST SCHEDULES

A series of computer programs have been written for the purpose of creating laboratory vibration schedules from field data. The programs are designed to automate the process as much as possible and require operator intervention only when judgements are required (such as shaping the schedules). The following description is a "walk through" of a typical development project once the field (raw) data have been collected and verified.

The program PSDFL computes PSDs from raw data and stores them in a file. The program assumes that the data are in normal PCM digital multiplexed form and are located on the data disc. The program makes use of a control file, $PSDCL, which contains:

a. The name of the calibration file (a file which contains the values required to convert the integer data to engineering units).

b. The name of the amplitude distribution file (a file which contains information on the location of the desired channels in the data stream and a brief location description of the desired channels).

c. The data sample rate.

d. The FFT block size (currently limited to 2048).

e. The word length (number of bits) of the data (typically 10).

f. The lower and upper frequencies to be analyzed.

g. The use (or not) of a Hanning window.

When the program is run, the operator enters the run number, the starting disc track (location of data on the disc) and the number of tracks to be used (the amount of data analyzed). The program creates a data storage file with a name based on the run number. Each segment of time domain data is windowed with a Hanning window to reduce spectral leakage if this option is selected. The program then computes three PSDs for each channel listed in the amplitude distribution file. The first PSD computed is a linear average of PSDs computed for segments of data of a length defined in the control file. During this analysis period, the standard deviation and the peak value for each spectral line are computed. One standard deviation is then added to the average value to create a PSD which represents the average value plus one standard deviation at each spectral line (limited by the peak value in each spectral line). Experience has shown that the variation in the data over a test run is sufficient to cause the standard deviation to be slightly larger than the average value, thus adding one standard deviation to the average has the effect of doubling the average value. Both this PSD (average plus one standard deviation) and the peak value PSD (largest value at each spectral line) are also saved in the file.

Each data file corresponds to a test run (specific test course, speed, and test condition) and consists of a major title (a line that specifies the amplitude distribution file used) and information on each channel analyzed, organized as follow:

a. An ASCII title line which contains the run number and a brief description of the channel location.

b. An ASCII information line which contains:

(1) The FFT block size.

(2) The data sample rate.

(3) The analysis bandwidth.

(4) The peak value contained within the PSD.

(5) The number of linear averages used.

(6) The use (or not) of a Hanning window.

c. A binary record block which contains formatted integer data. (The data are formatted by dividing the entire spectrum by the peak value, then multiplying these values by 10,000 to save file storage space; i.e., integer numbers use 1/2 the storage space of real numbers.)

The program PSDFL is run on the data for N runs with data from X channels being analyzed from each run (note that X need not be the same for each run). The program will produce N PSD files (one for each run).

At this point, an overlay process is started. A program called PKPSD is used to create the overlayed spectrum. The operator enters (via a control file) the name of the master storage file, the names of the data files created by PSDFL (essentially, the data runs to be analyzed), the data elements (channel locations) within those files to be analyzed (those locations for which a common spectrum is desired), which PSD values are to be used in the overlay process (average, average +1 standard deviation or peak) and the number of standard deviations (due to the overlay process) to be added to the average value computed during the overlay process. The program does not require that the data elements to be analyzed be the same for each file analyzed; however, all data to be compared must have the same analysis bandwidth (a check is made by the program and the data are rejected if this is not the case).

The data normally used for the overlay process for each particular channel to be included in the process are the average plus one standard deviation PSD data. Some of the rationale for the use of these data (rather than the average or the maximum) are as follow:

a. The peak value at each spectral point is a value that occurs rarely (once) and is susceptible to contamination by noise (false data from any source). To create a schedule based on peak data is to assume that the test item is subjected to such an environment for a reasonable length of time, which is false. The result is an overtest.

b. Some conservatism is built in by adding a standard deviation to the average to account for other terrain and vehicles for which no data were obtained, effects of tire pressure, vehicle wear, track tension, etc.

The program computes the average and the standard deviation of all PSD's to be overlayed (at each spectral line) and again saves the average plus X (selected by the operator, but normally 1) standard deviations (limited by the largest value at each spectral line encountered during the overlay process). Conservatism is thus added twice during the overlay process. The use of the average plus standard deviation curve from the individual location PSD's accounts for variations in a single location during a data run while the addition of a standard deviation during the overlay process accounts for variations among locations or test runs (courses). The standard deviations are computed during separate processes and do not have the same values.

It is the responsibility of the operator to determine the data locations and data runs to be overlayed and to insure that the data for each of the runs and locations chosen are valid. The program PKPSD prints the channel description of each channel used in the overlay process so that the operator may verify that the requested data have been analyzed. The rms value of each of the individual spectra is computed and printed with a recommendation to discard any data with an rms value less than 1/3 the average (all elements overlayed) or more than 3 times the average rms value. Locations which fit this description (if any) are identified, but no action to delete these locations is taken by the program.

A program called CRVIB is next used on the master (overlayed) spectrum to define the break points (frequency and amplitude points which define the spectrum in the digital vibration control system) and allow the operator to smooth the spectrum for laboratory simulation. The master spectrum is plotted on a graphics terminal in a log-log format, and the cursor is turned on. The operator may position the cursor at any location on the plot and enter the location of the point (frequency and amplitude) by hitting any key (except E). The location of the cursor, in screen coordinates, is converted to engineering units of frequency (Hz) and amplitude (g^2/Hz), and these values are stored in a file. The program utilizes the "rubber band line" technique when the cursor is moved, thus giving the operator a preview of the smoothed spectrum. The use of a log-log domain plot allows better resolution in the low frequency portion of the spectrum which contains most of the spectral energy.

Laboratory test time can be reduced over actual exposure time in the field by applying an exaggeration factor to the amplitude (PSD) values of the schedule. The rationale is based on an equivalent damage theory assuming that the failure mechanism is fatigue. The techniques for computing an exaggeration factor are based on a detailed knowledge of the test vehicle real-world scenario (i.e., the real-world exposure time), the desired test time and the material fatigue characteristics. The accepted equation for test time compression is:

$$(W_1/W_2)^{b/n} = T_2/T_1$$

where

- W_1 = field PSD amplitude
- W_2 = laboratory PSD amplitude
- T_1 = real world exposure time
- T_2 = laboratory test time
- b = 9 (endurance curve constant)
- n = 2.4 (stress-damping constant).

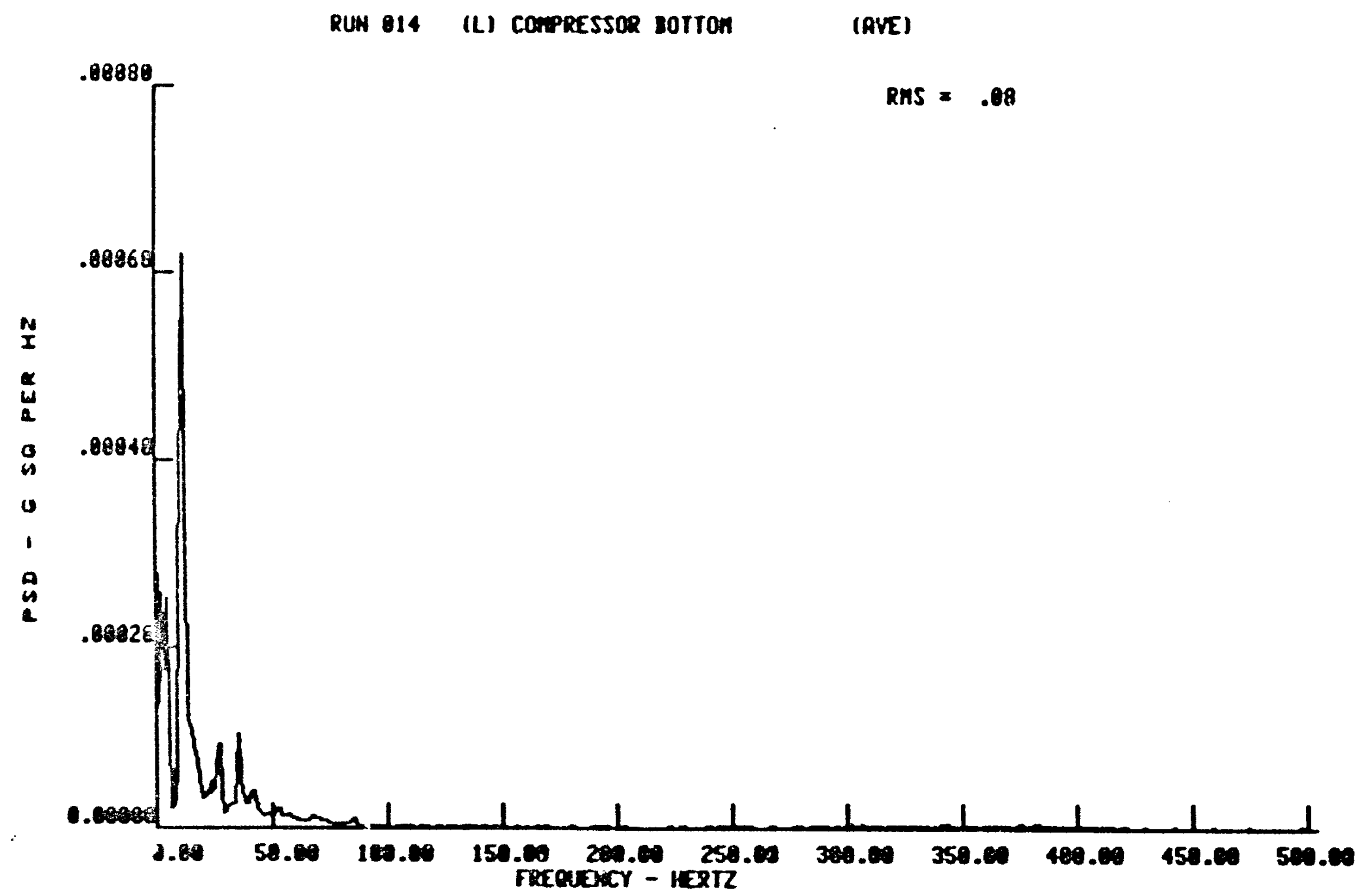
The breakpoints (and thus the spectrum) are now exaggerated using the program CRPSD. It is left to the operator to compute the value of the exaggeration factor based on the desired test time to real time ratio. The operator enters the exaggeration factor (by which the PSD levels are amplified) and the name of a new storage file into which the exaggerated spectral data will be stored. The program takes the breakpoint data from the applicable file, multiplies the amplitudes by the exaggeration factor and stores the values into the new file. The program then takes the new breakpoints (exaggerated) and generates a complete spectrum (with the same analysis bandwidth) by calculating points between breakpoints using a straight line fit in the log-log domain. This created spectrum (the actual laboratory schedule) is stored in a separate file also named by the operator. A program called SHAKR is then run using the just developed laboratory spectrum as data to insure that shaker displacement limits are not exceeded by the test schedule. The program compares the spectral value at each frequency from 5 to 15 Hz with the maximum value known to function properly on the USACSTA system and alerts the operator to any changes required in the spectrum.

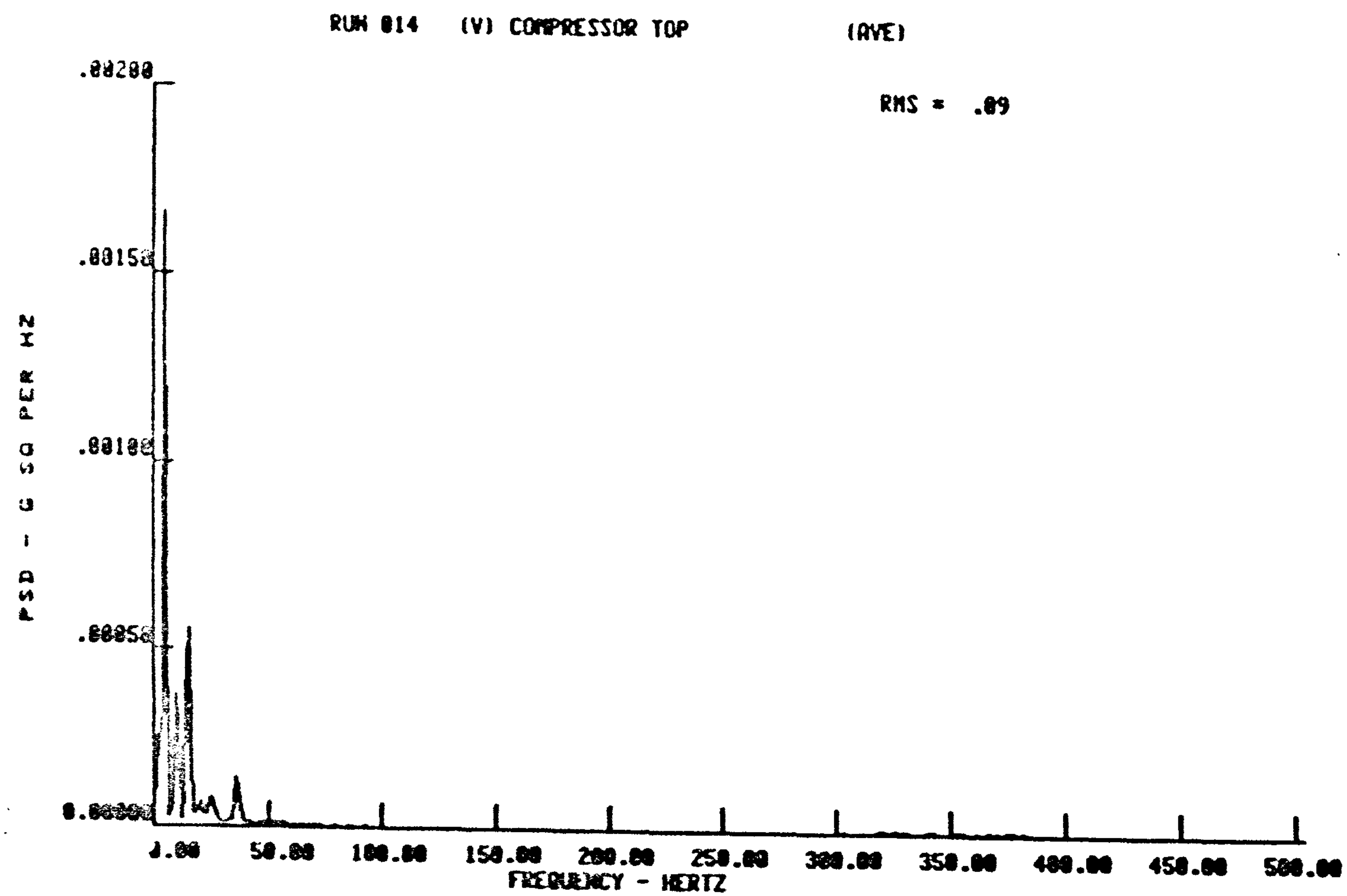
REPRESENTATIONS OF THE (COMPUTER COMBINED) VIBRATION AVERAGES

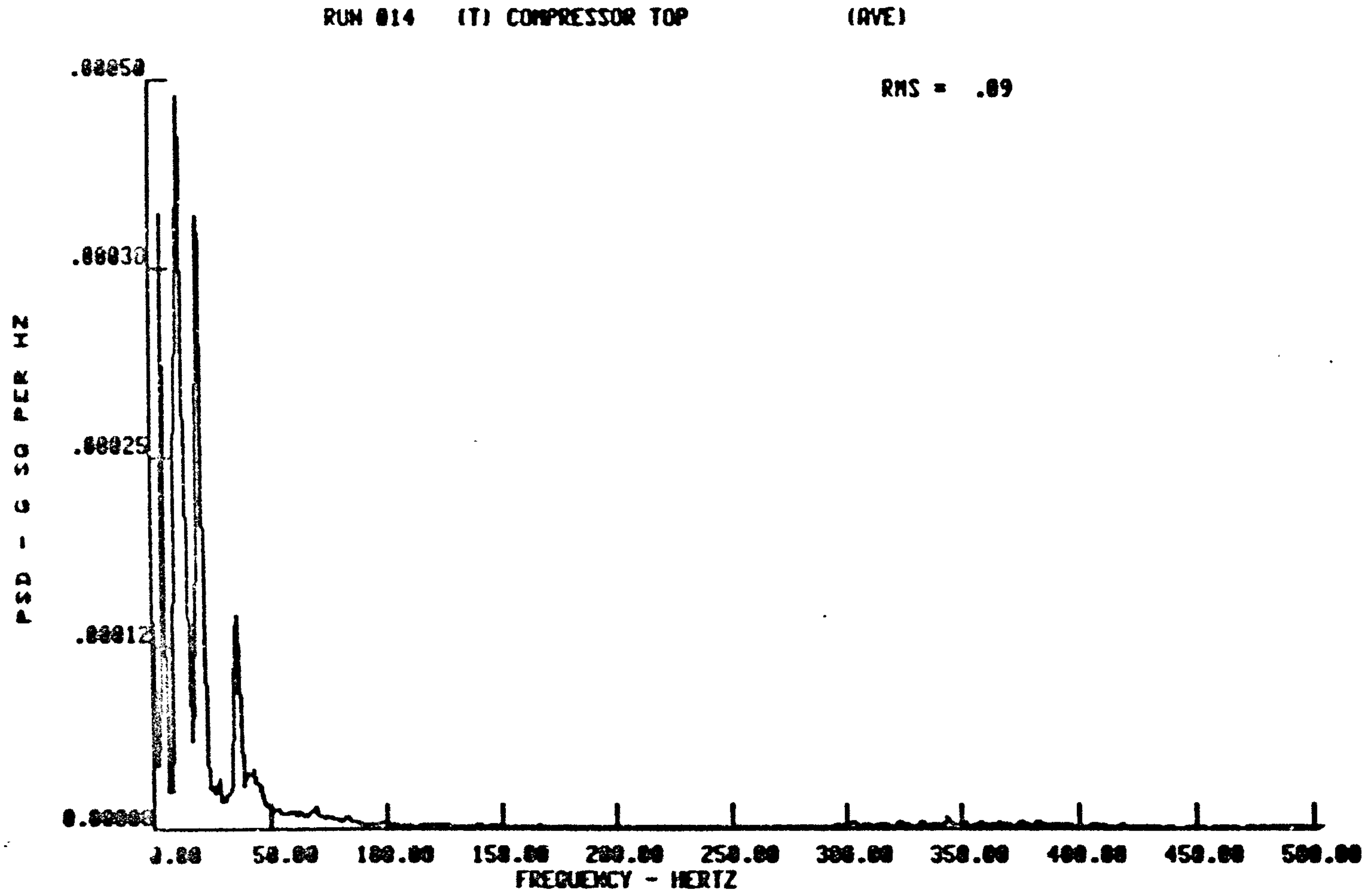
FOR EACH MONITORED DATA CHANNEL

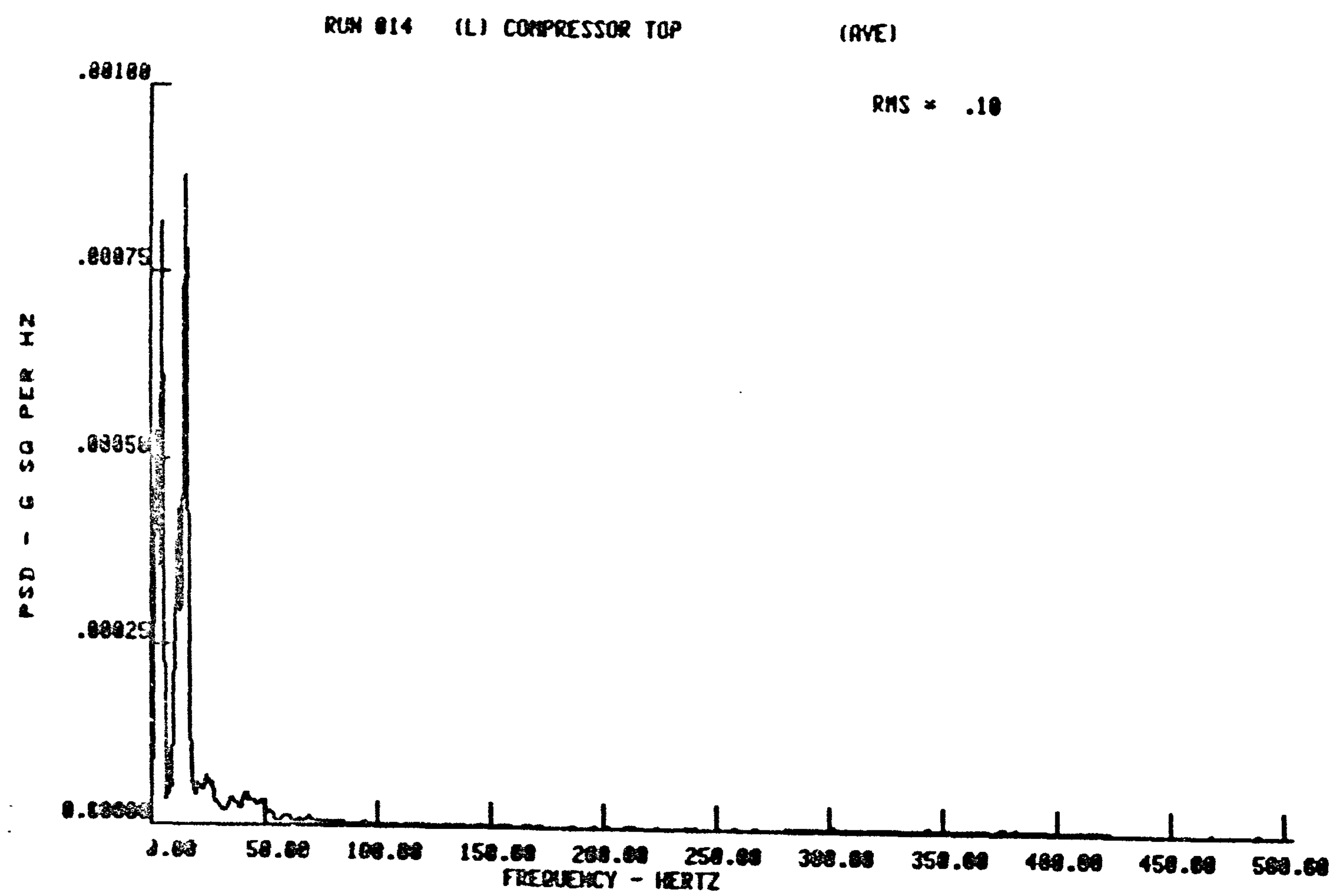
DURING THE TRANSPORTATION PROFILE TEST

OF THE 18K BTU HORIZONTAL AIR CONDITIONER

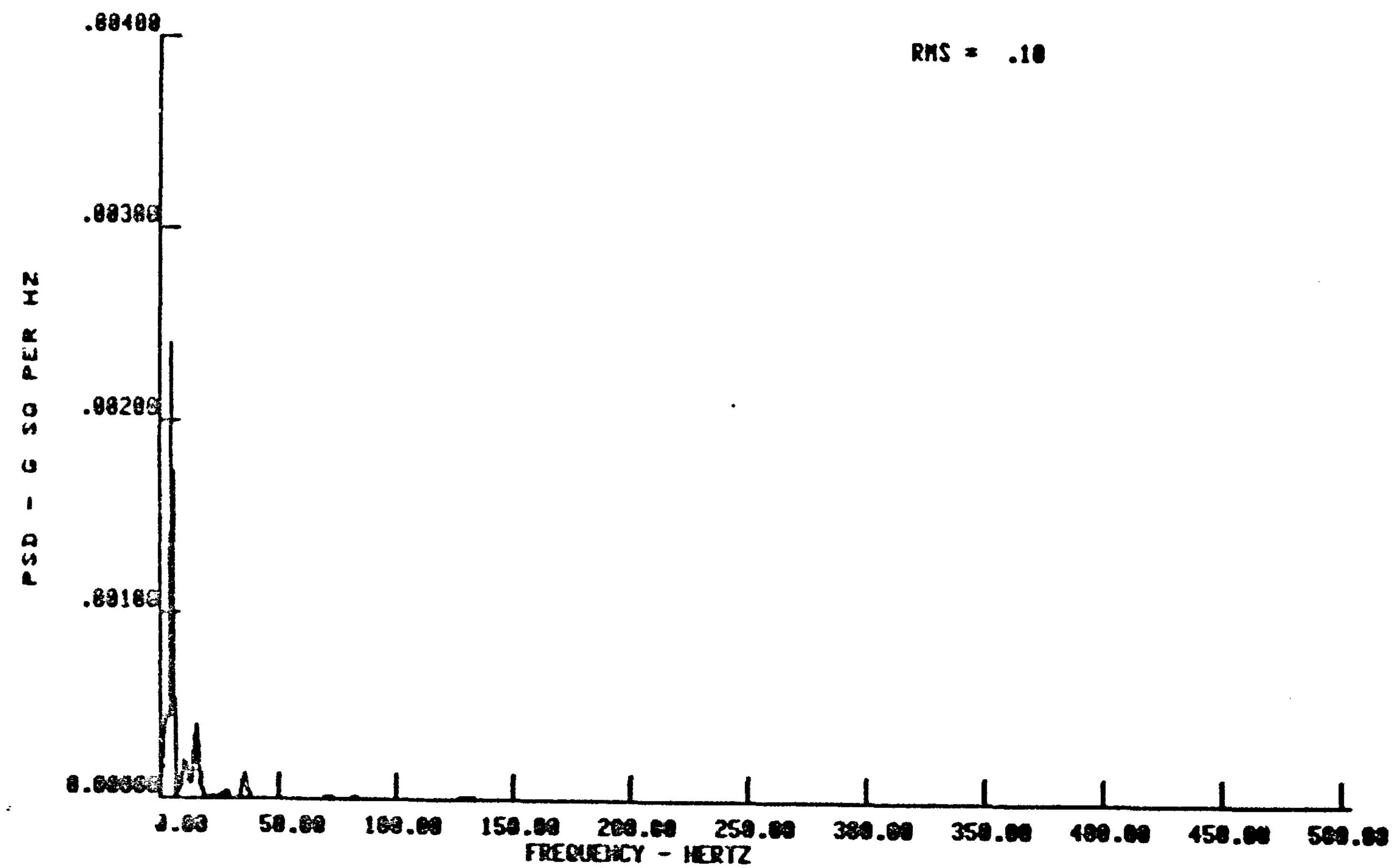

RUN 014 (L) COMPRESSOR BOTTOM (AVE)
RMS = .08
PSD - G SQ PER HZ
.00080
.00060
.00040
.00020
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ


RUN 014 (V) COMPRESSOR TOP (AVE)
RMS = .09
.00200
.00150
.00100
.00050
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

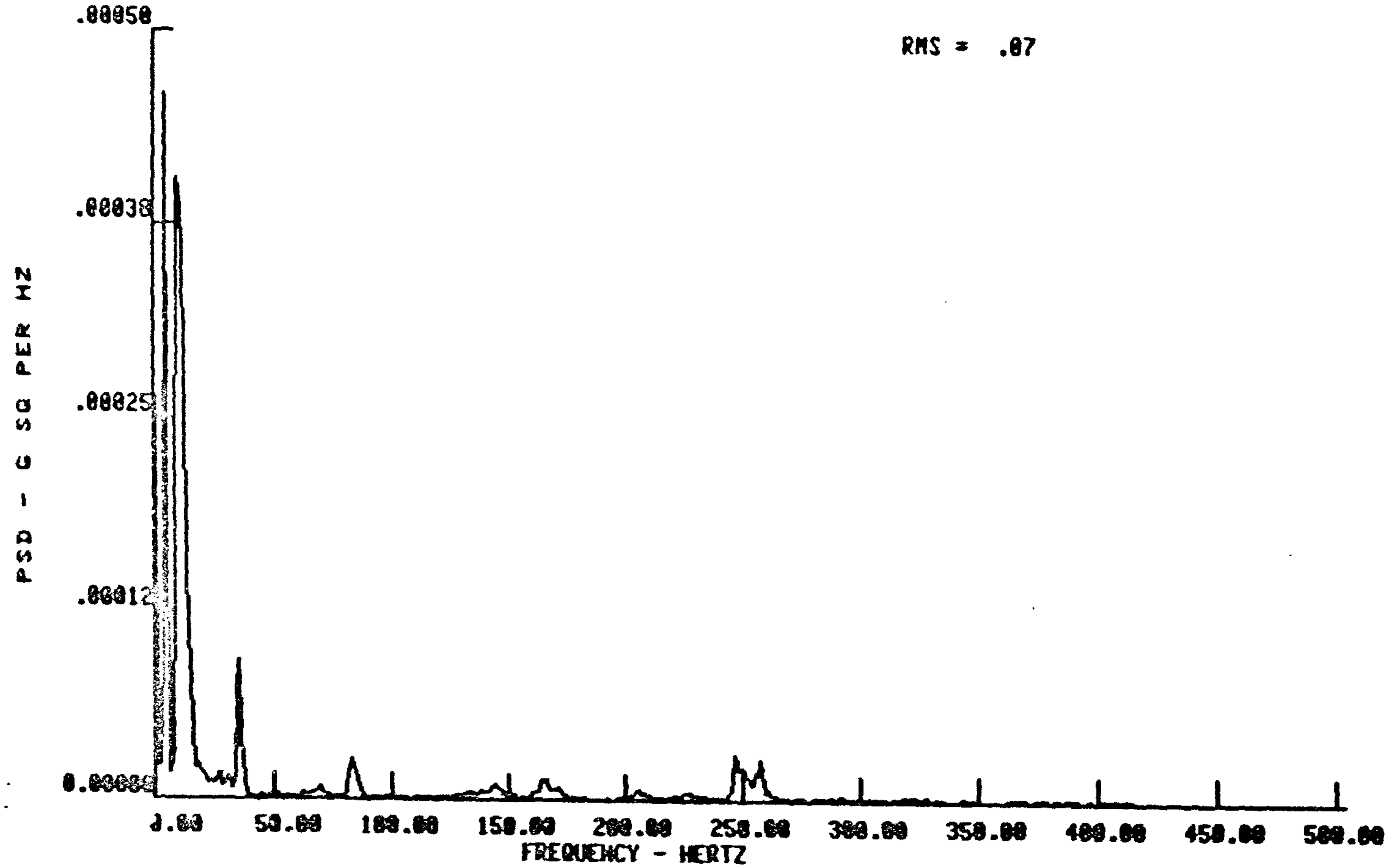

RUN 014 (T) COMPRESSOR TOP (AVE)
RMS = .09
PSD - G SQ PER HZ
.00050
.00030
.00025
.00012
0.00000
1.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

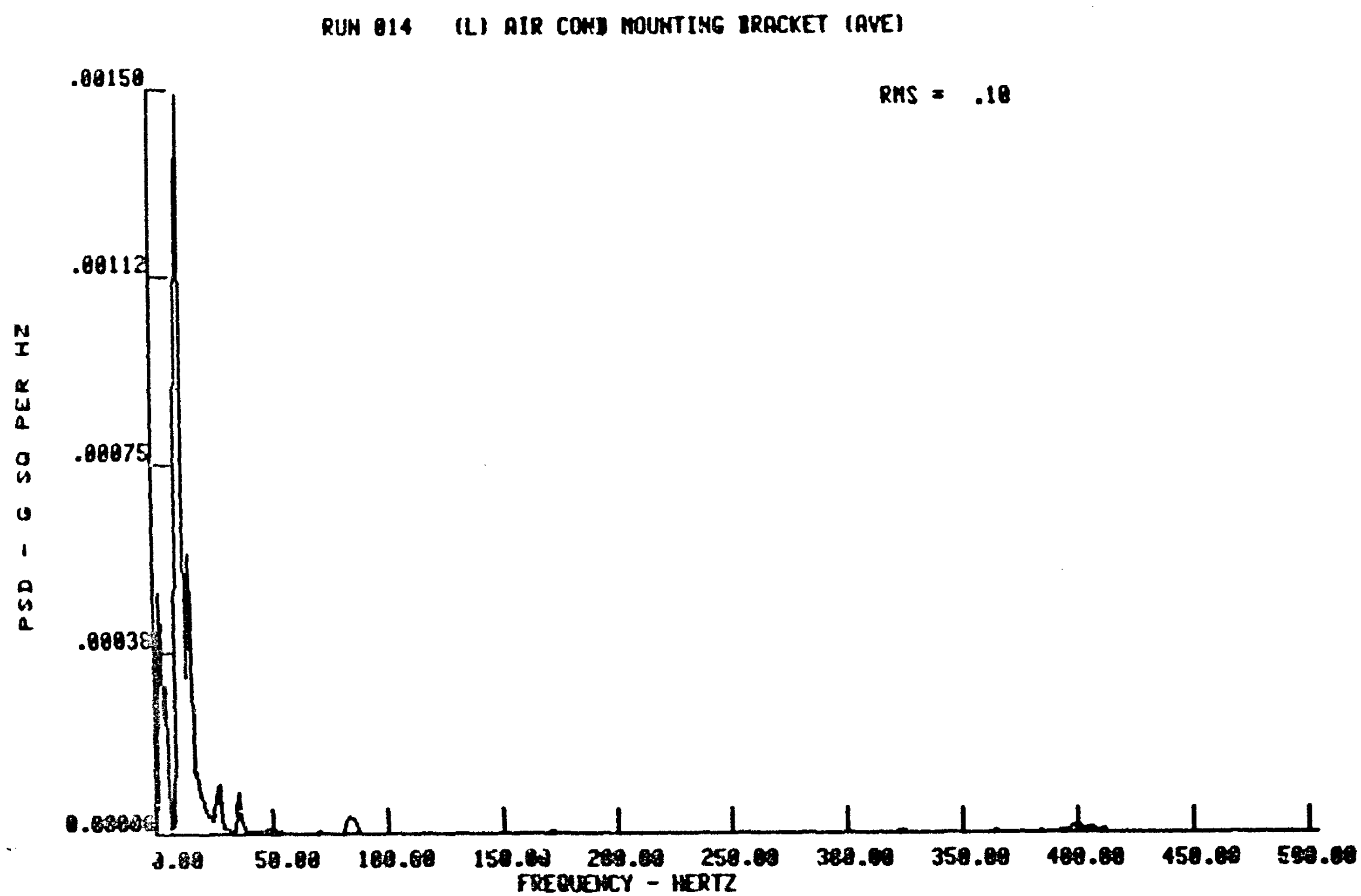

RUN 014 (L) COMPRESSOR TOP (AVE)
RMS = .10
.00100
.00075
.00050
.00025
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

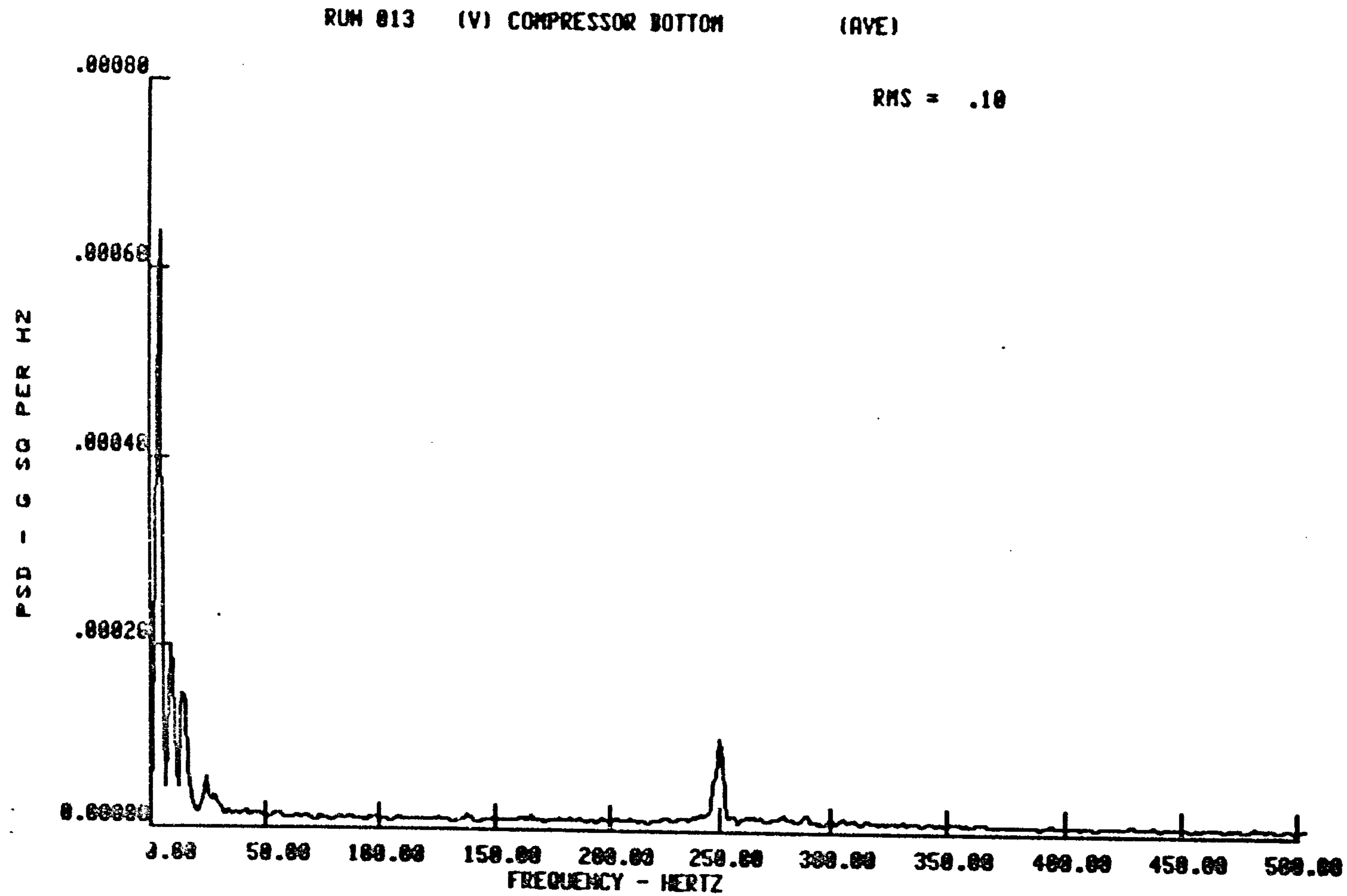
RUN 014 (V) AIR COND MOUNTING BRACKET (AVE)

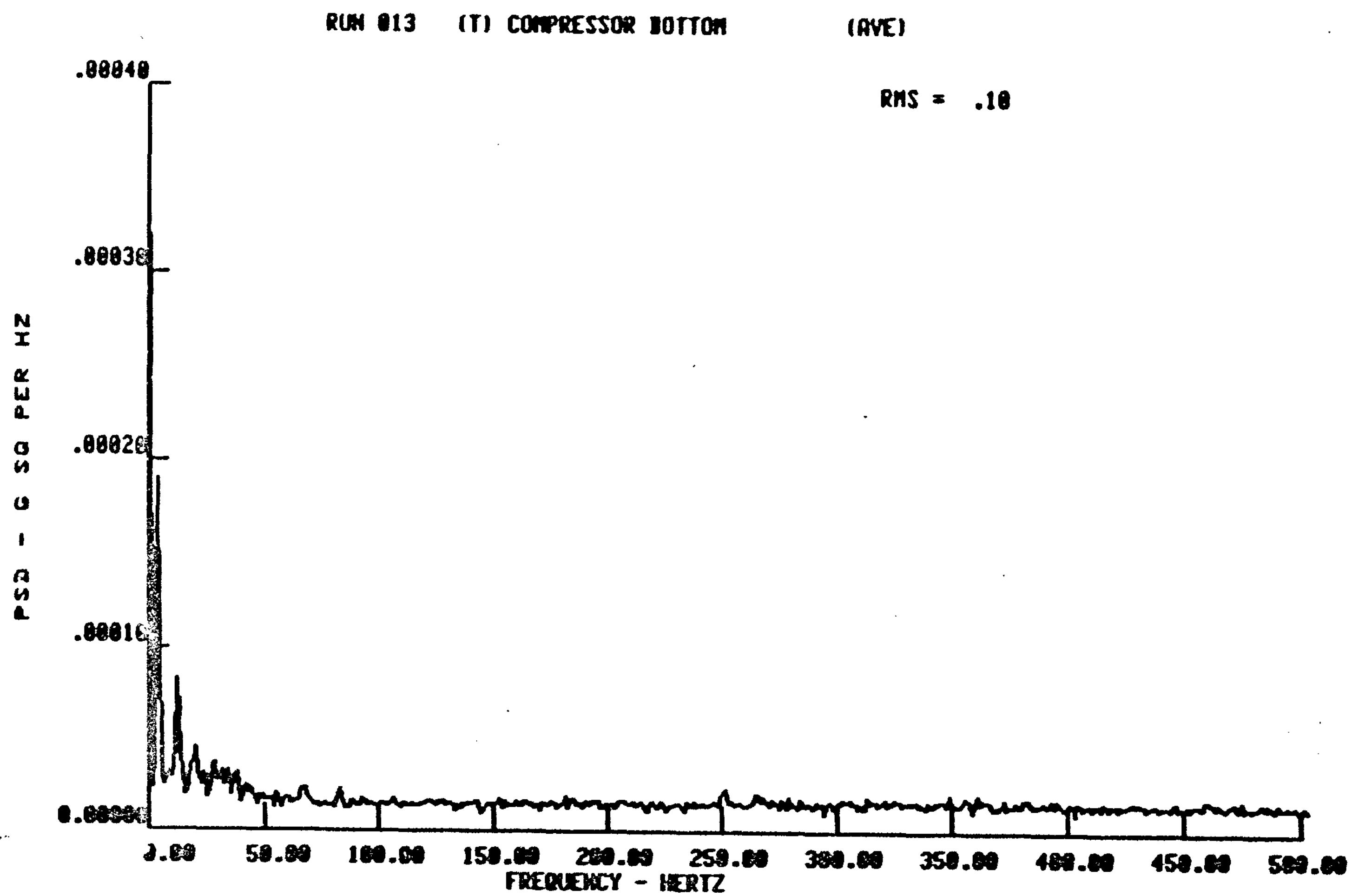


RUN 014 (T) AIR COND MOUNTING BRACKET (AVE)



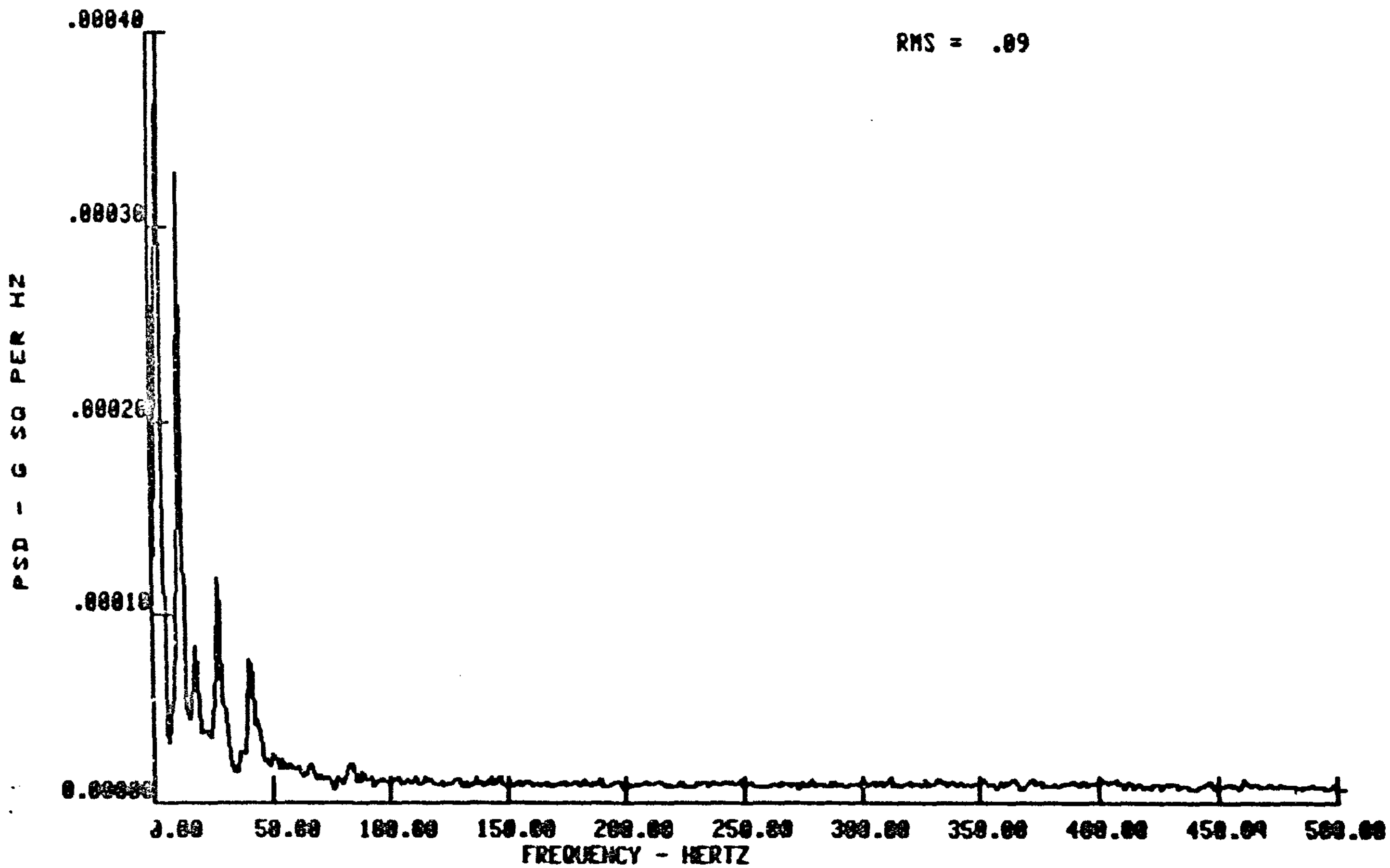

RUN 014 (L) AIR COND MOUNTING BRACKET (AVE)
RMS = .10
.00150
.00112
.00075
.00038
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ


RUN 013 (V) COMPRESSOR BOTTOM (AVE)
RMS = .10
PSD - G SQ PER HZ
.00080
.00060
.00040
.00020
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

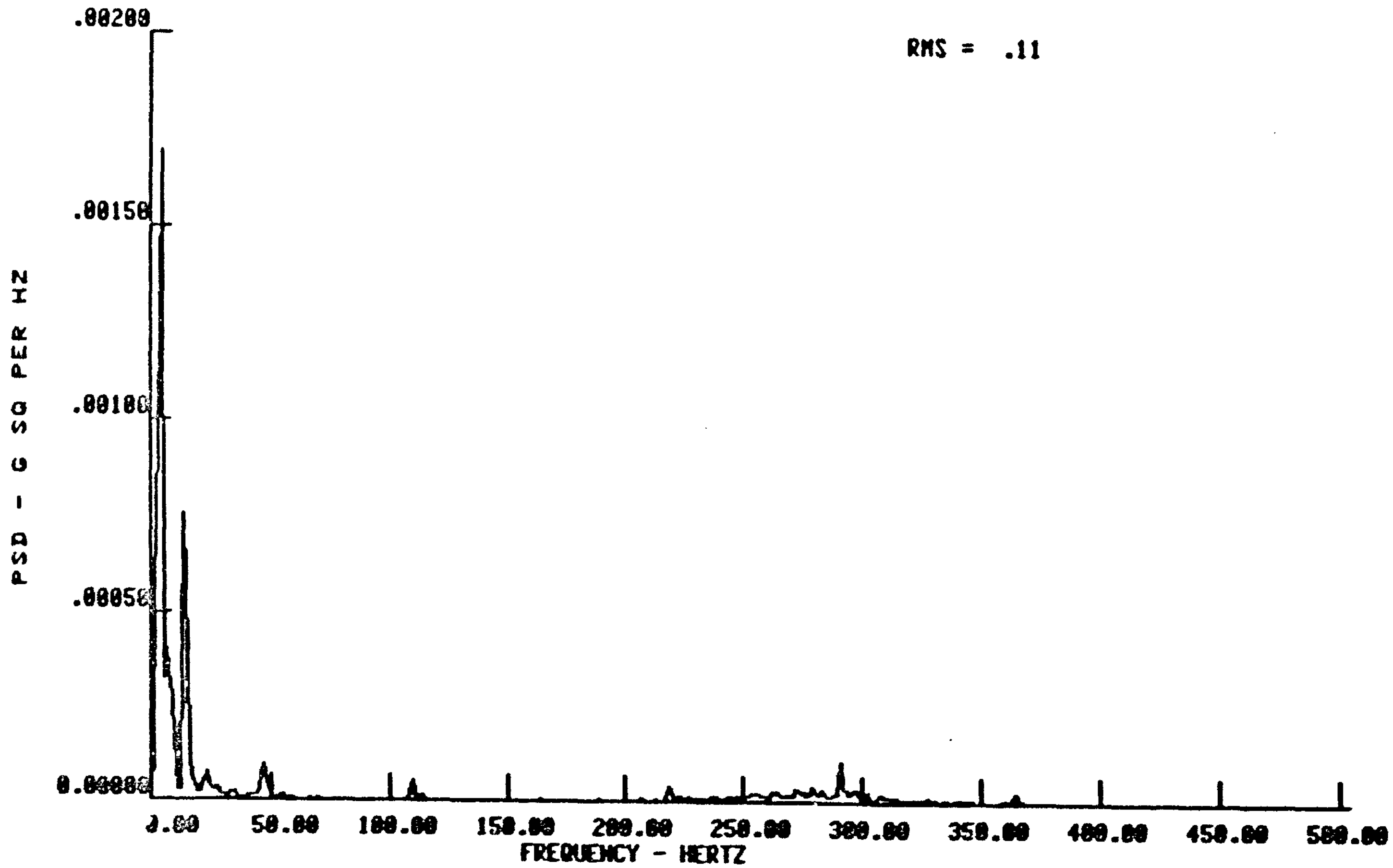


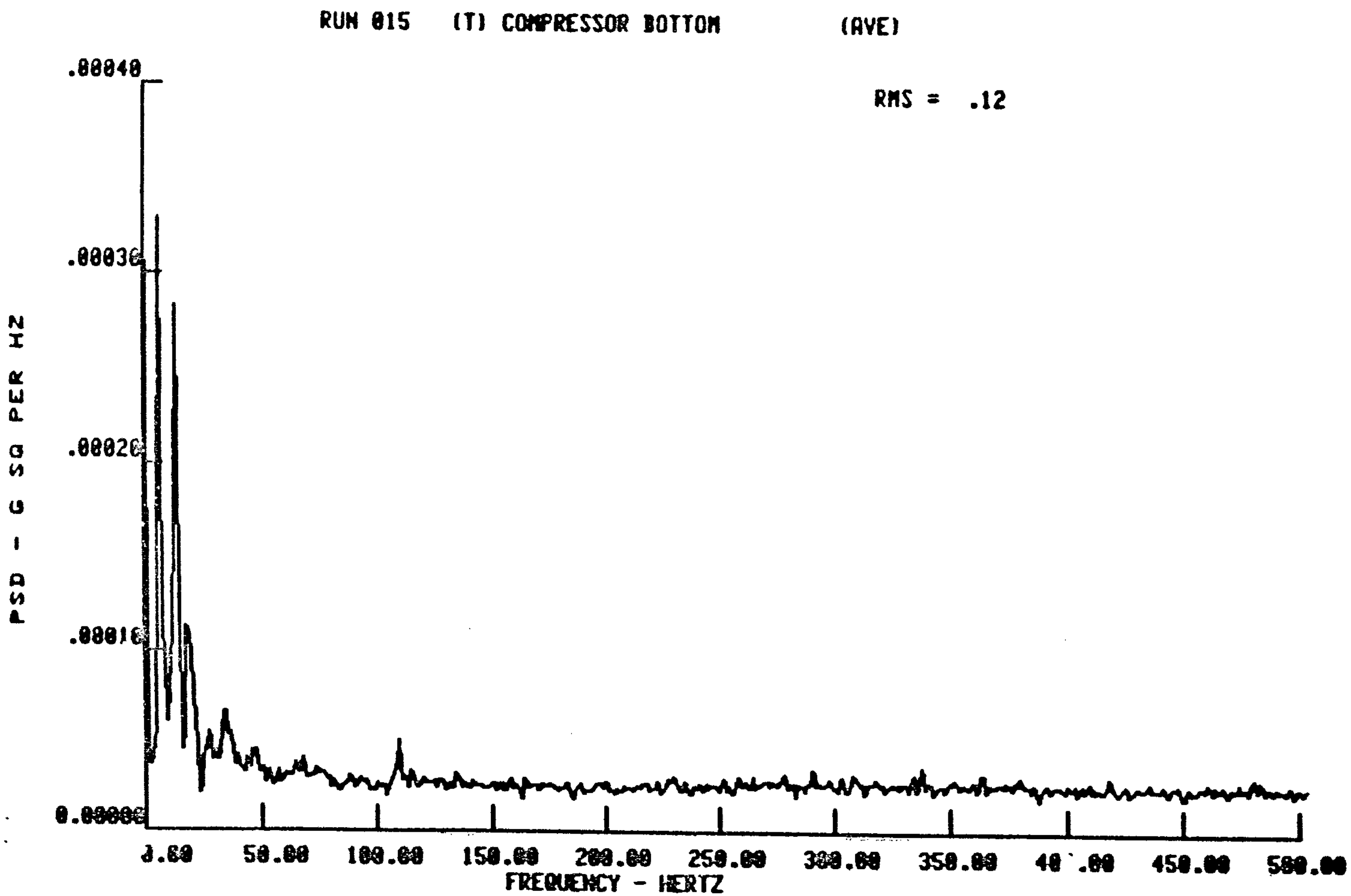
RUN 013 (T) COMPRESSOR BOTTOM (AVE)
RMS = .10
.00040
.00030
.00020
.00010
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

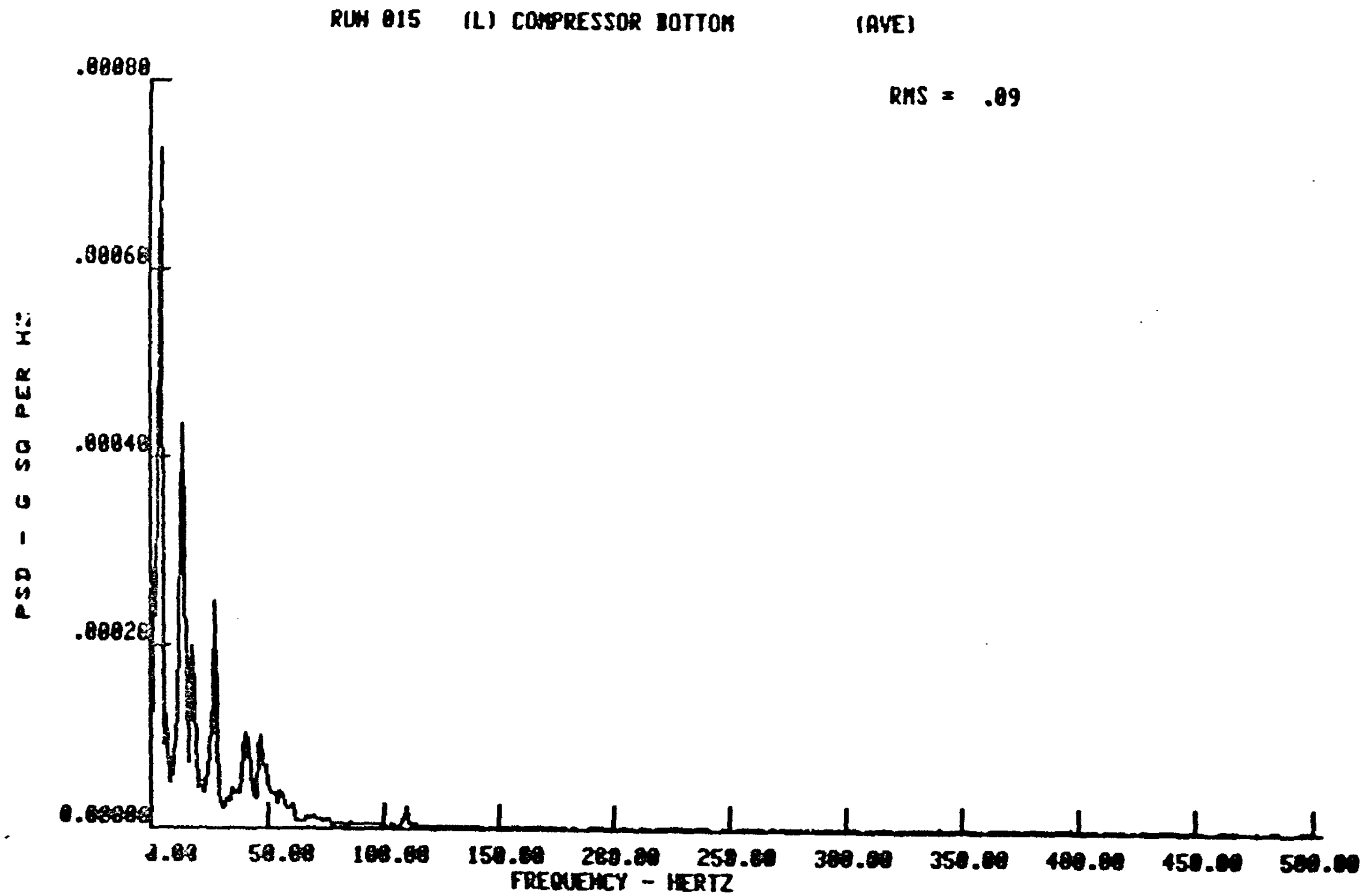
RUN 013 (L) COMPRESSOR BOTTOM (AVE)



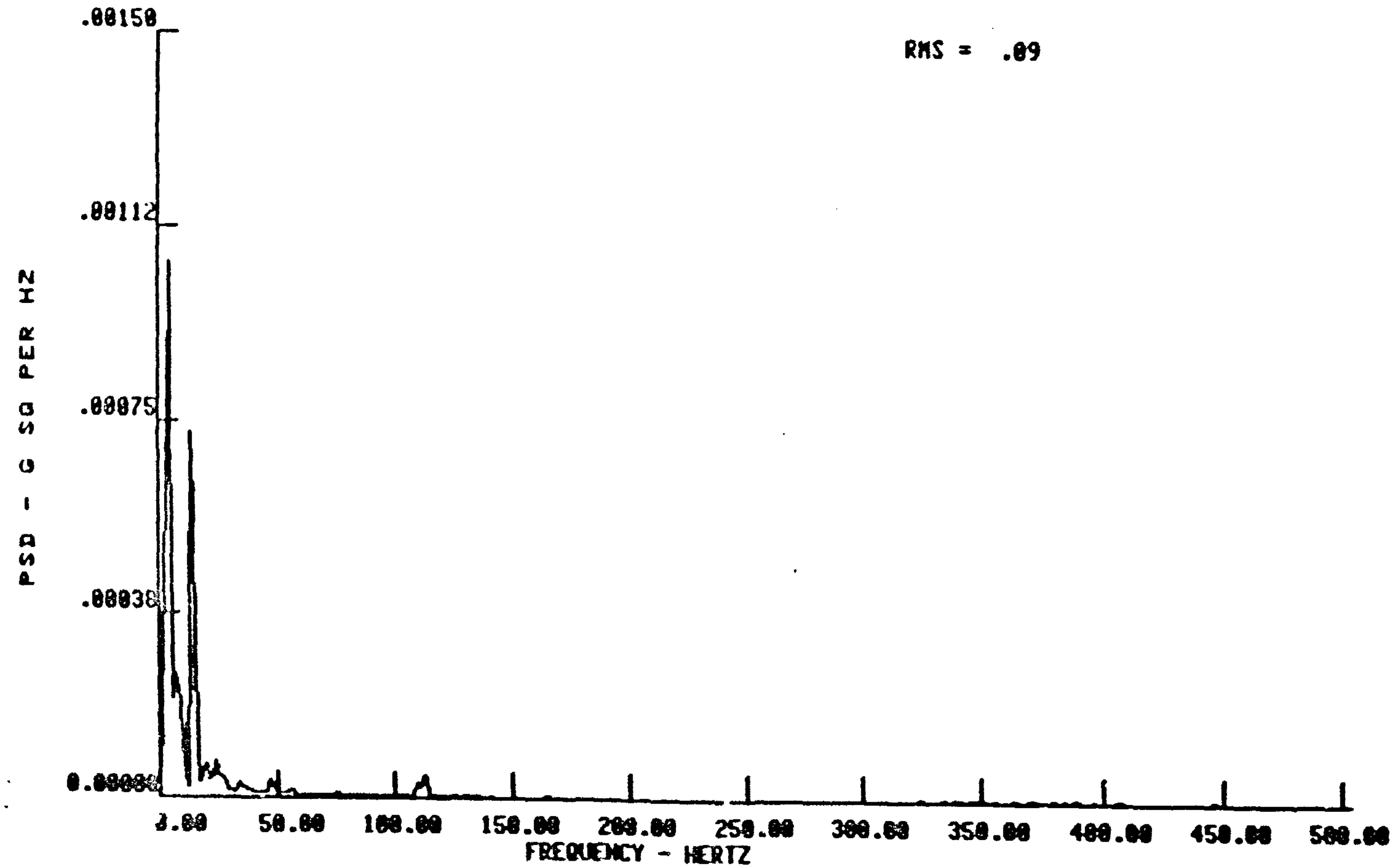
RUN 015 (V) COMPRESSOR BOTTOM (AVE)

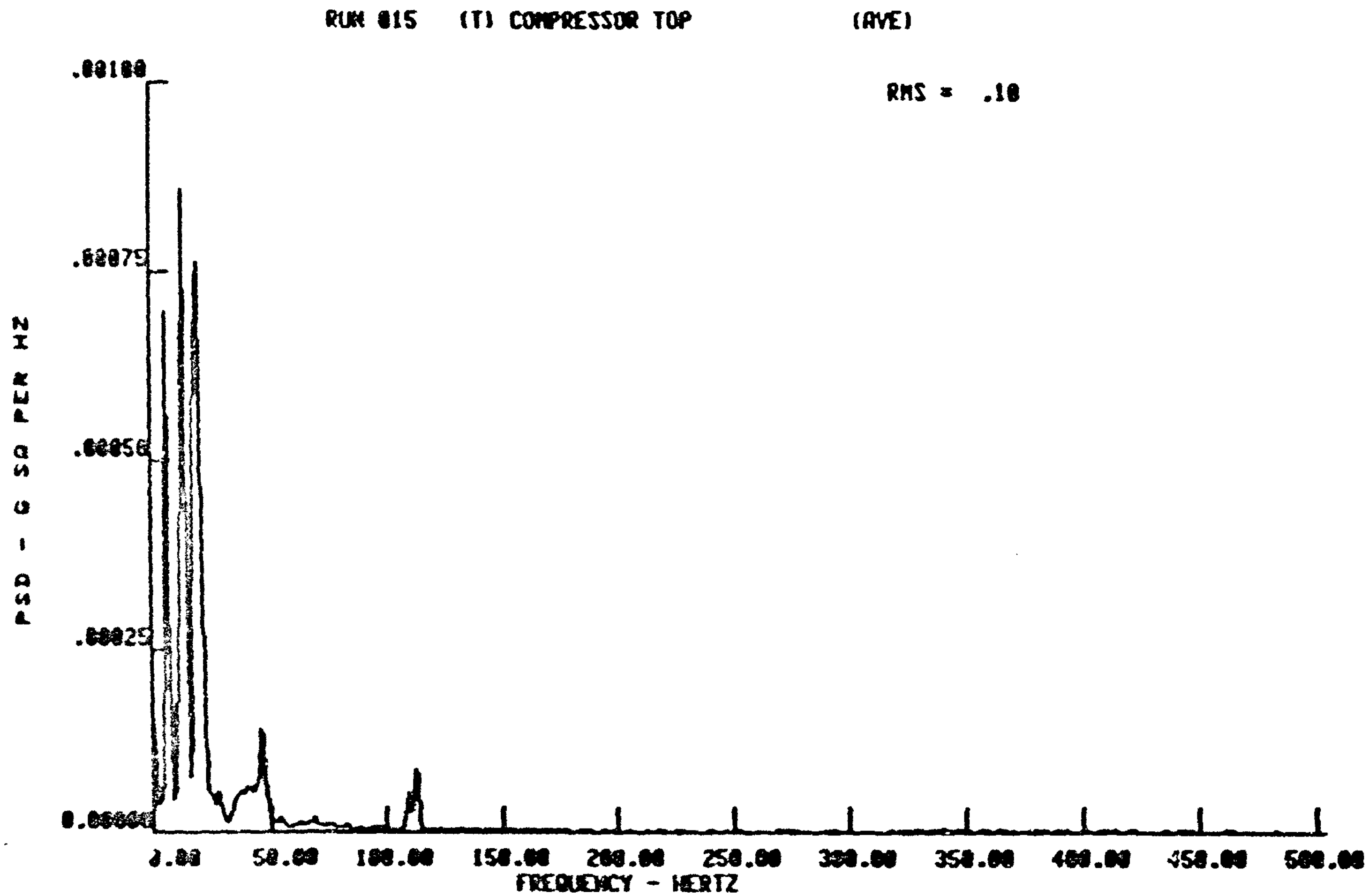


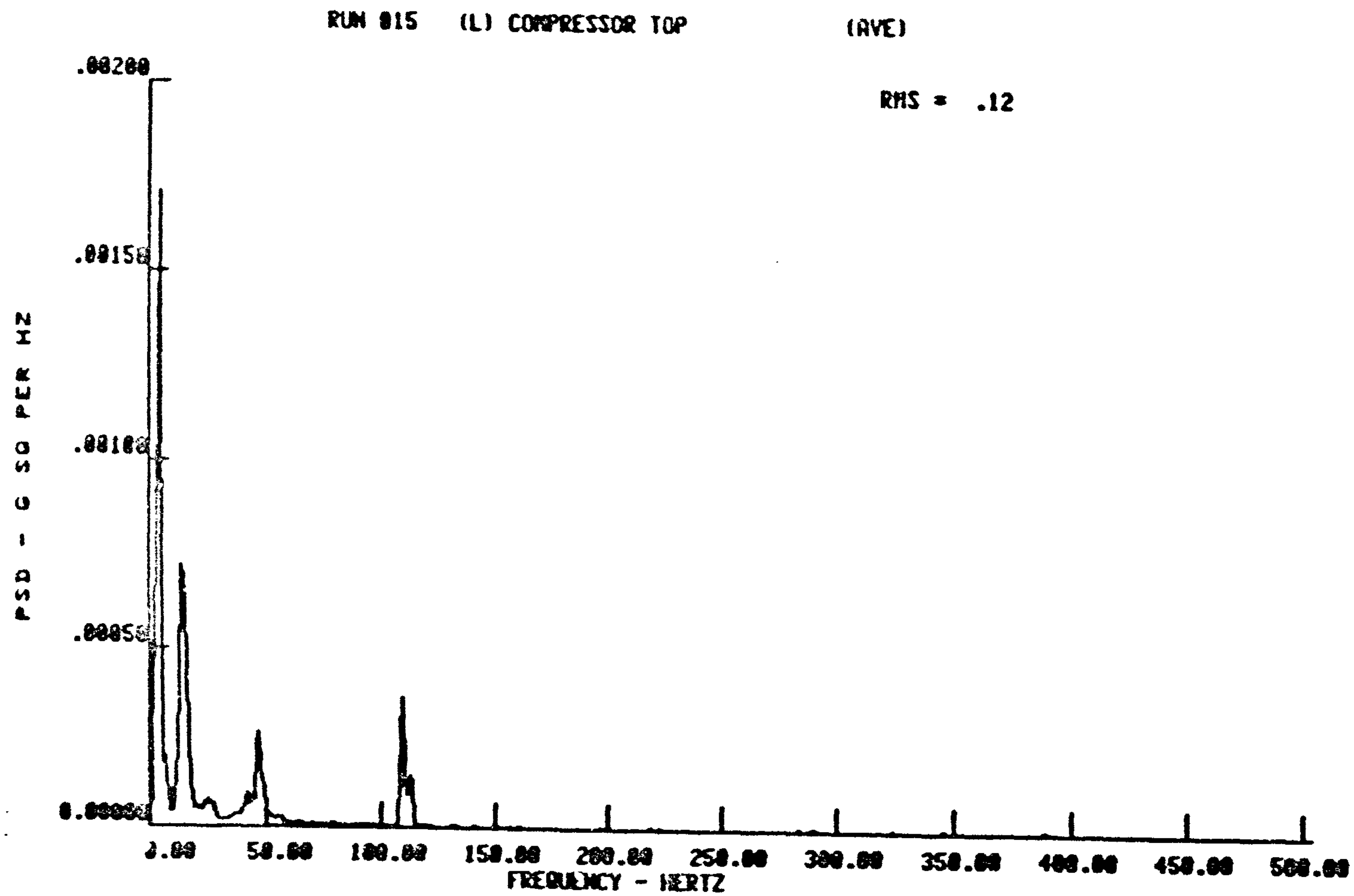

RUN 015 (T) COMPRESSOR BOTTOM (AVE)
RMS = .12
PSD - G SQ PER HZ
.00040
.00030
.00020
.00010
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ


RUN 015 (L) COMPRESSOR BOTTOM (AVE)
RMS = .09
PSD - G SQ PER HZ
.00080
.00060
.00040
.00020
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

RUN 015 (V) COMPRESSOR TOP (AVE)

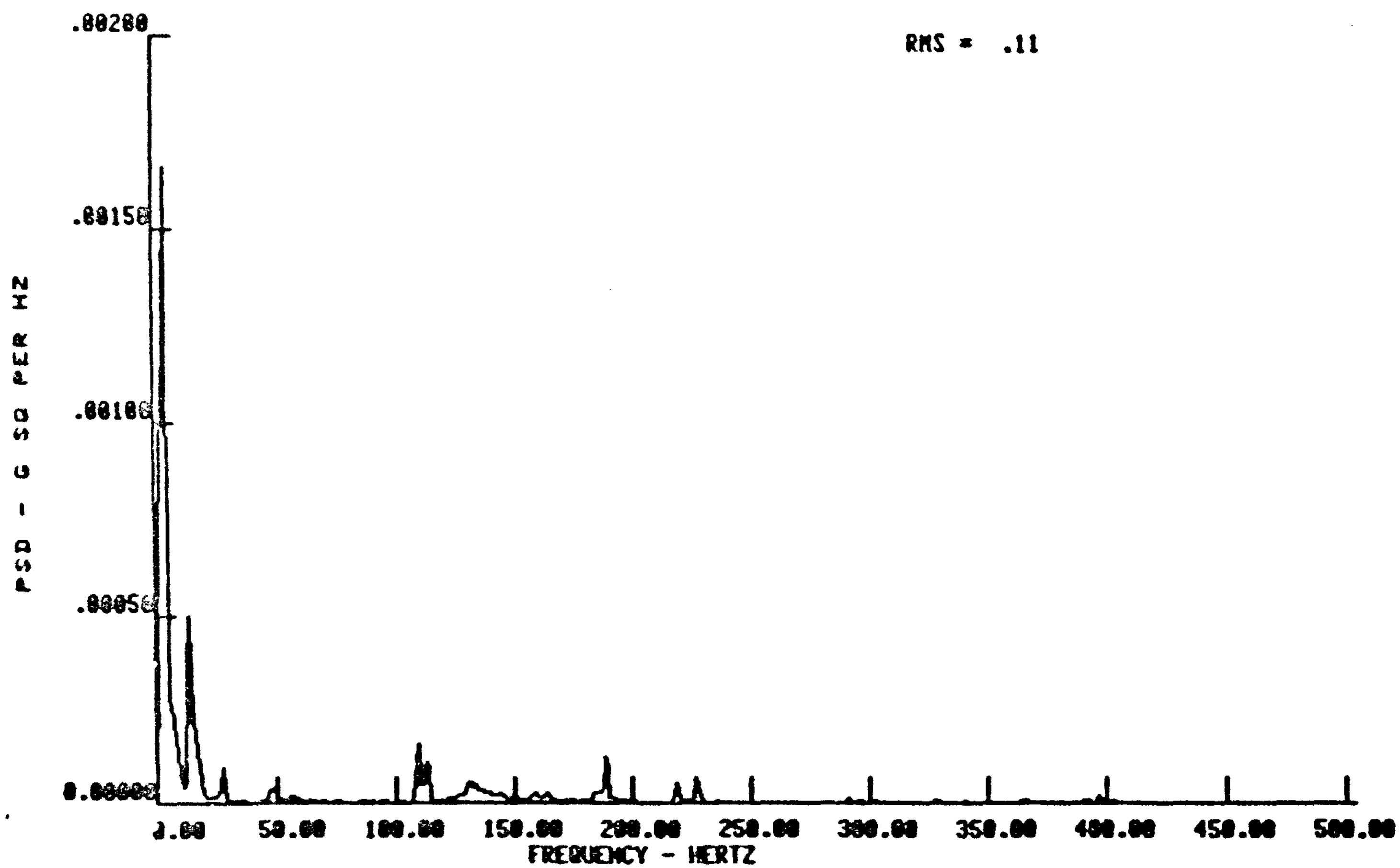


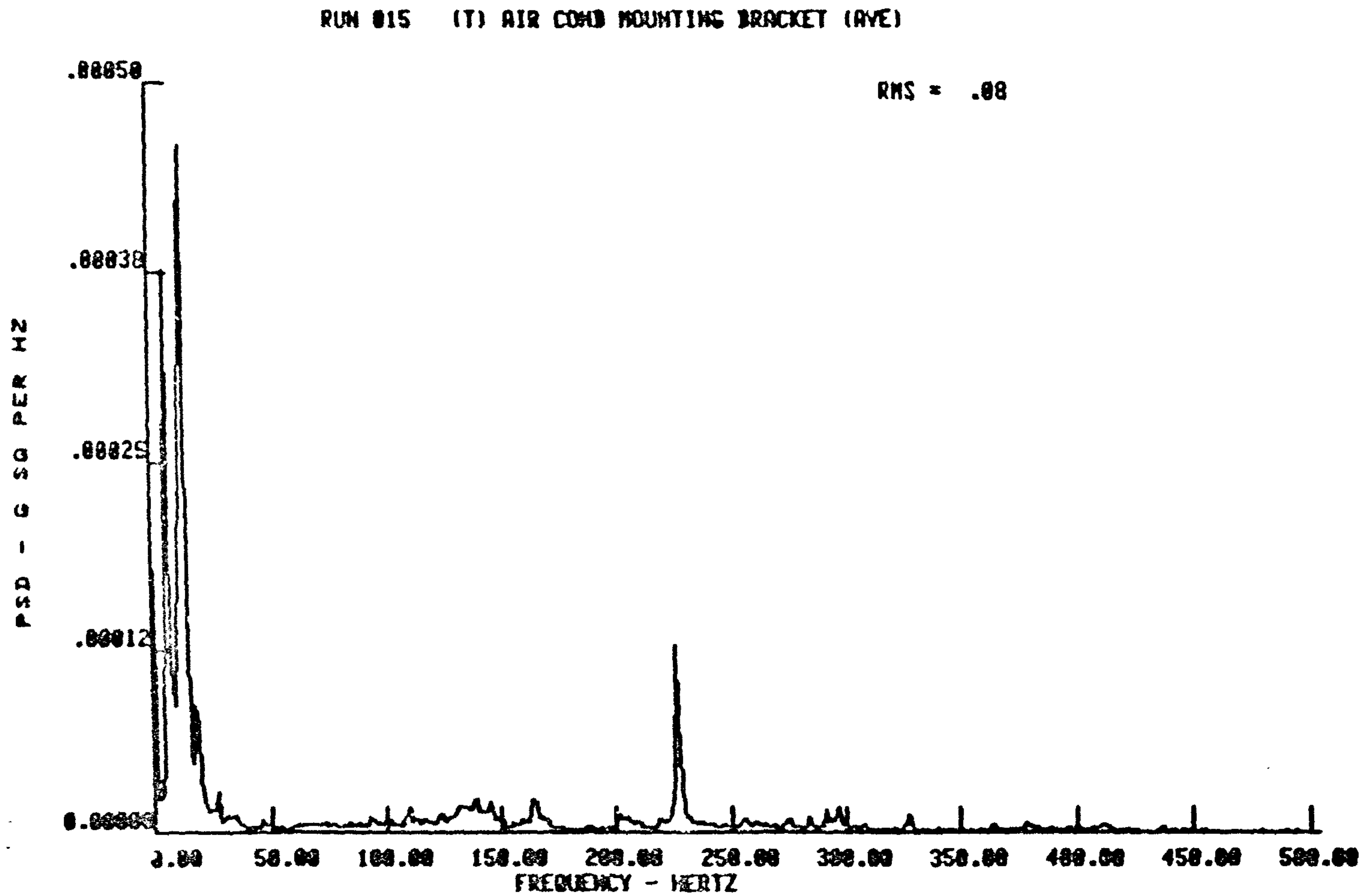

RUN 015 (T) COMPRESSOR TOP (AVE)
RMS = .10
.00100
.00075
.00050
.00025
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ



RUN 015 (L) COMPRESSOR TOP (AVE)
RMS = .12
.00200
.00150
.00100
.00050
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

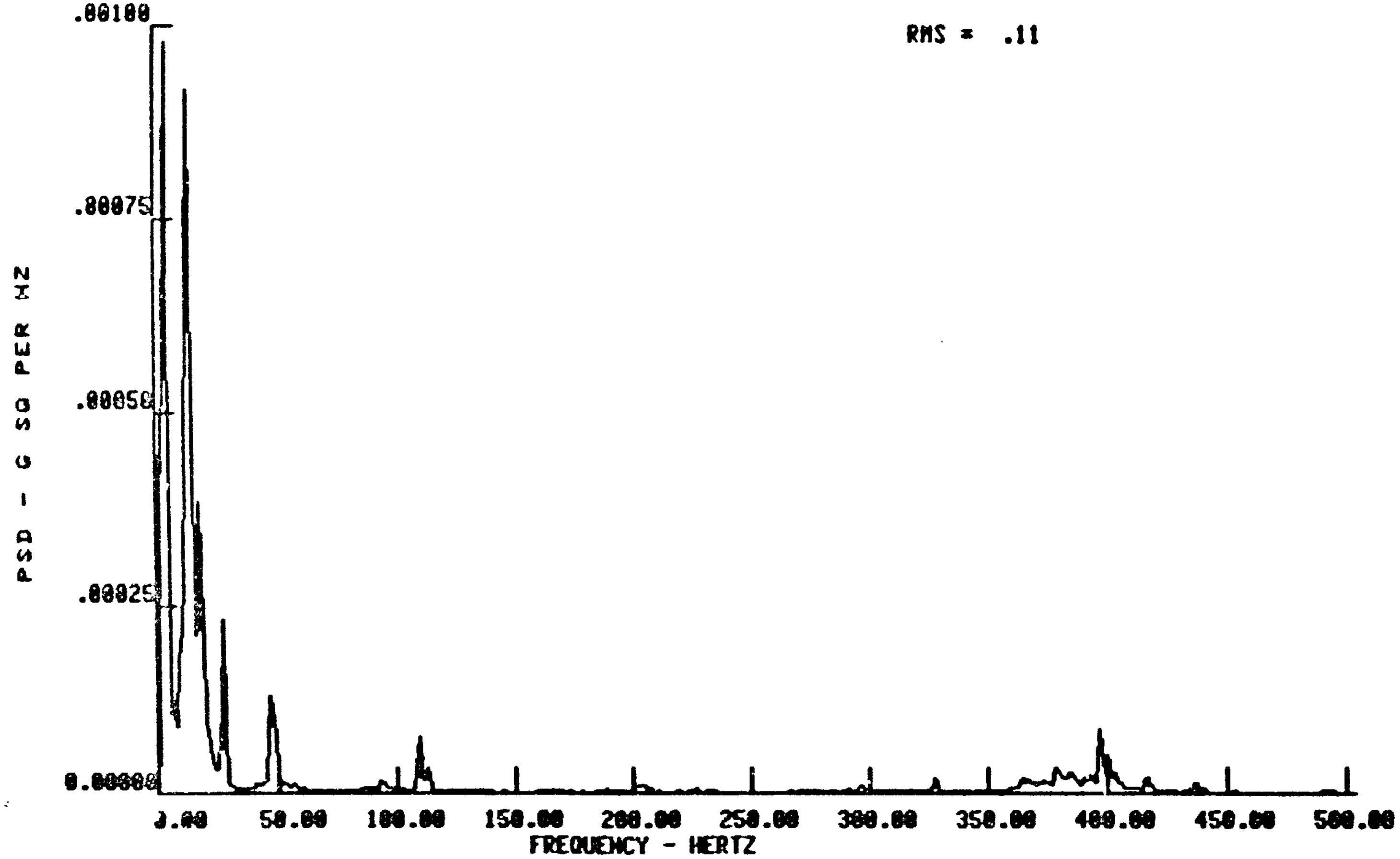
RUN 015 (V) AIR COND MOUNTING BRACKET (AVE)

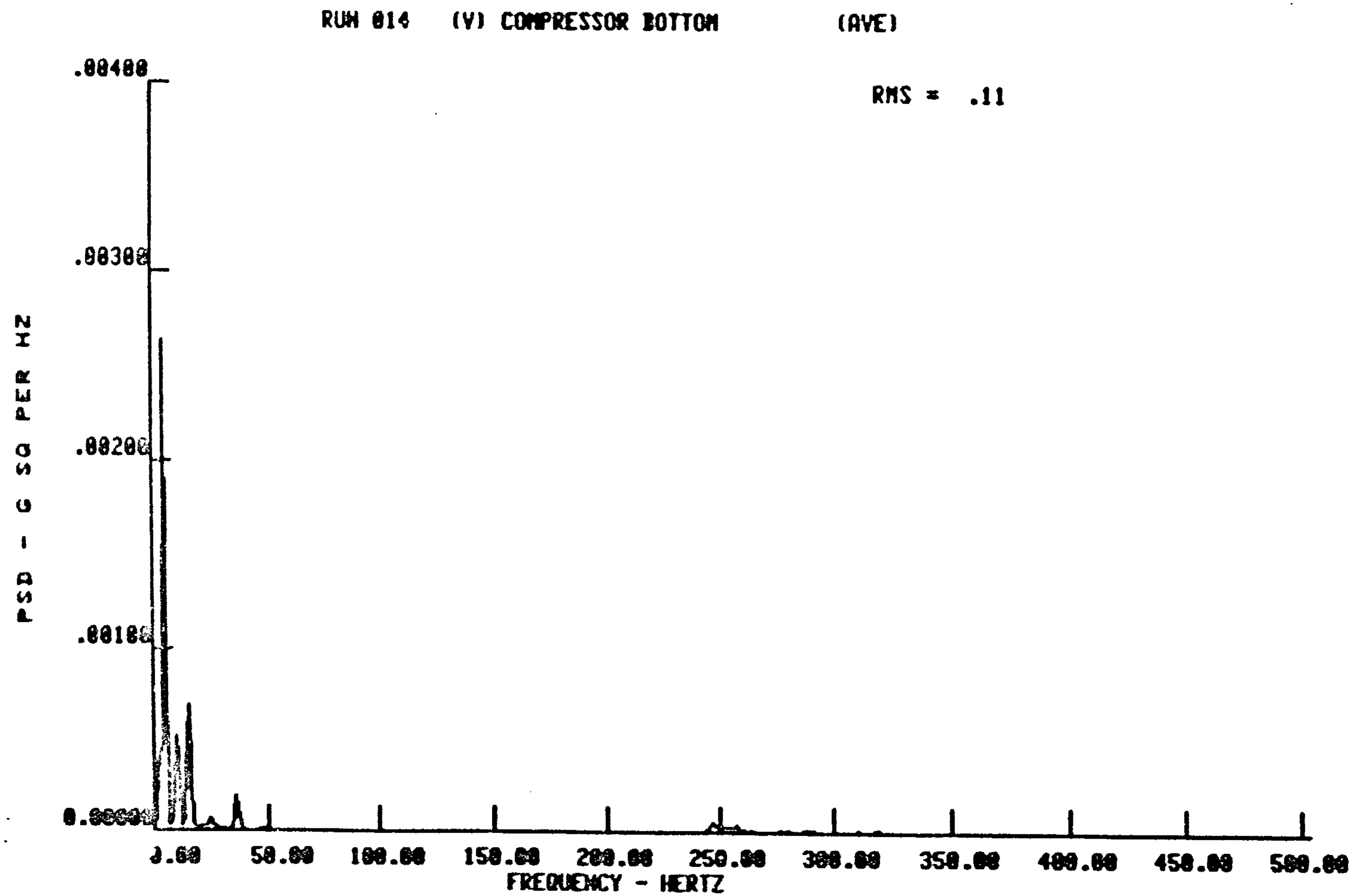


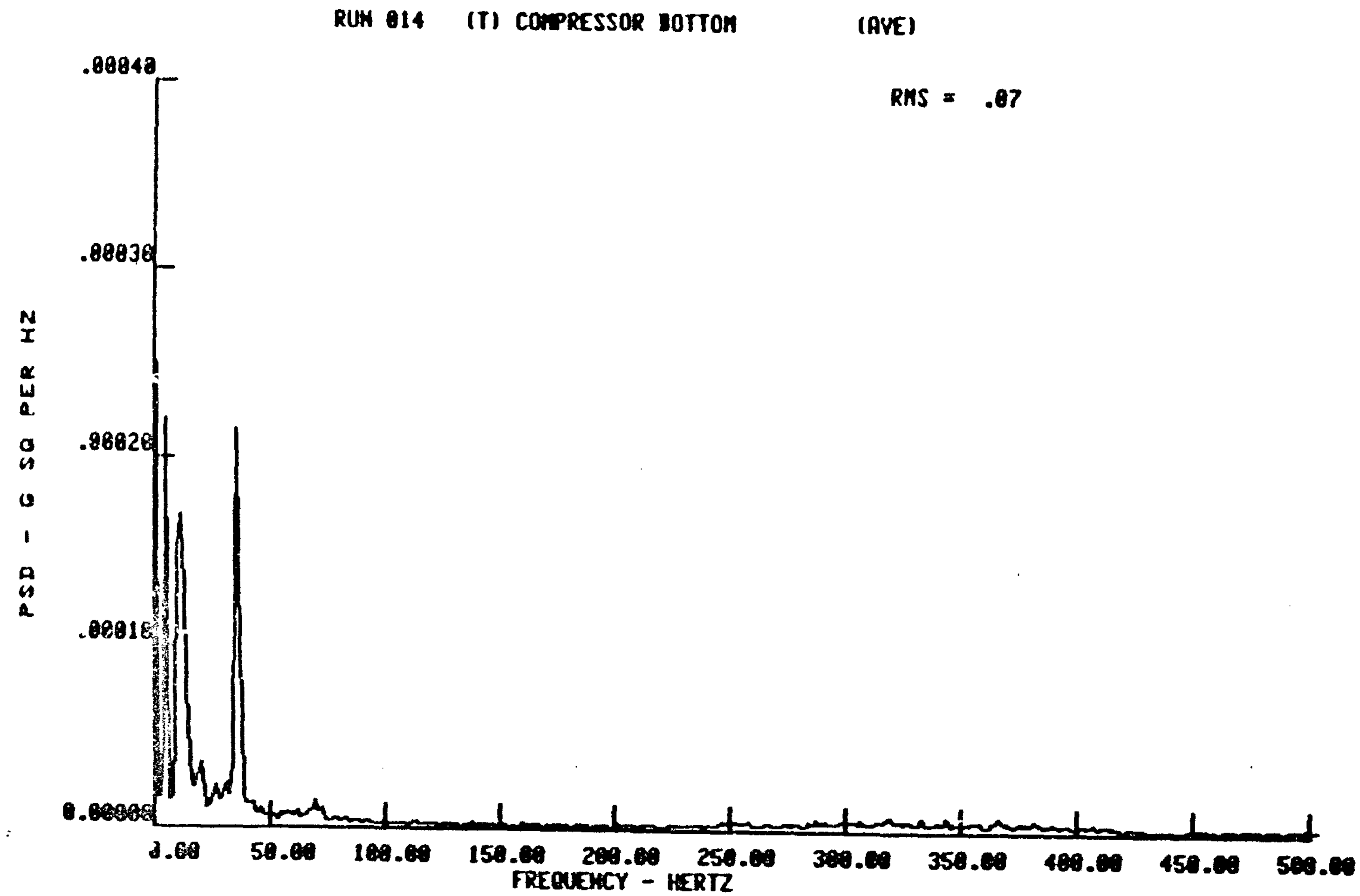


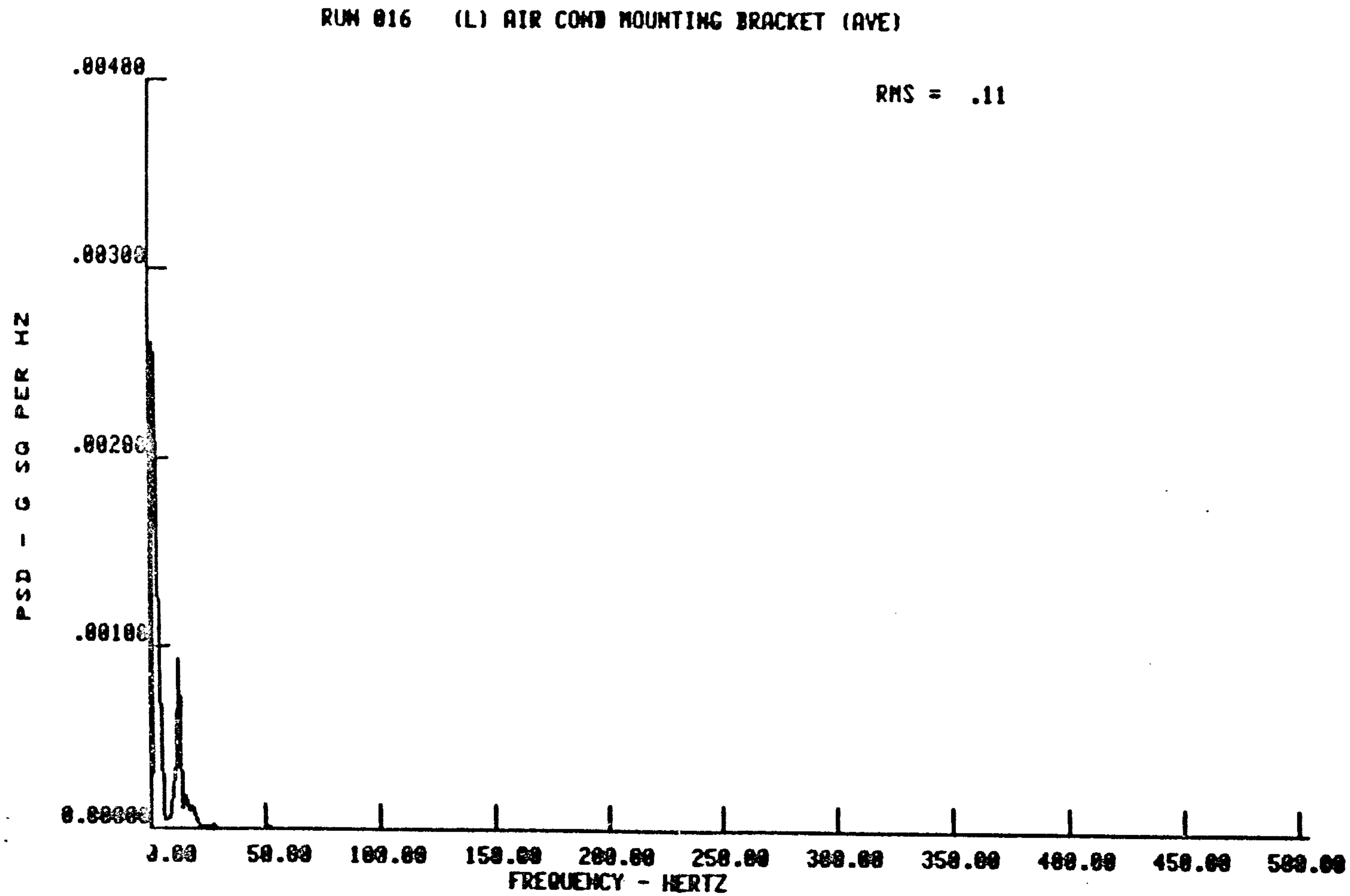
RUN 015 (T) AIR COND MOUNTING BRACKET (AVE)
RMS = .08
.00050
.00038
.00025
.00012
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

RUN 015 (L) AIR COND MOUNTING BRACKET (AVE)



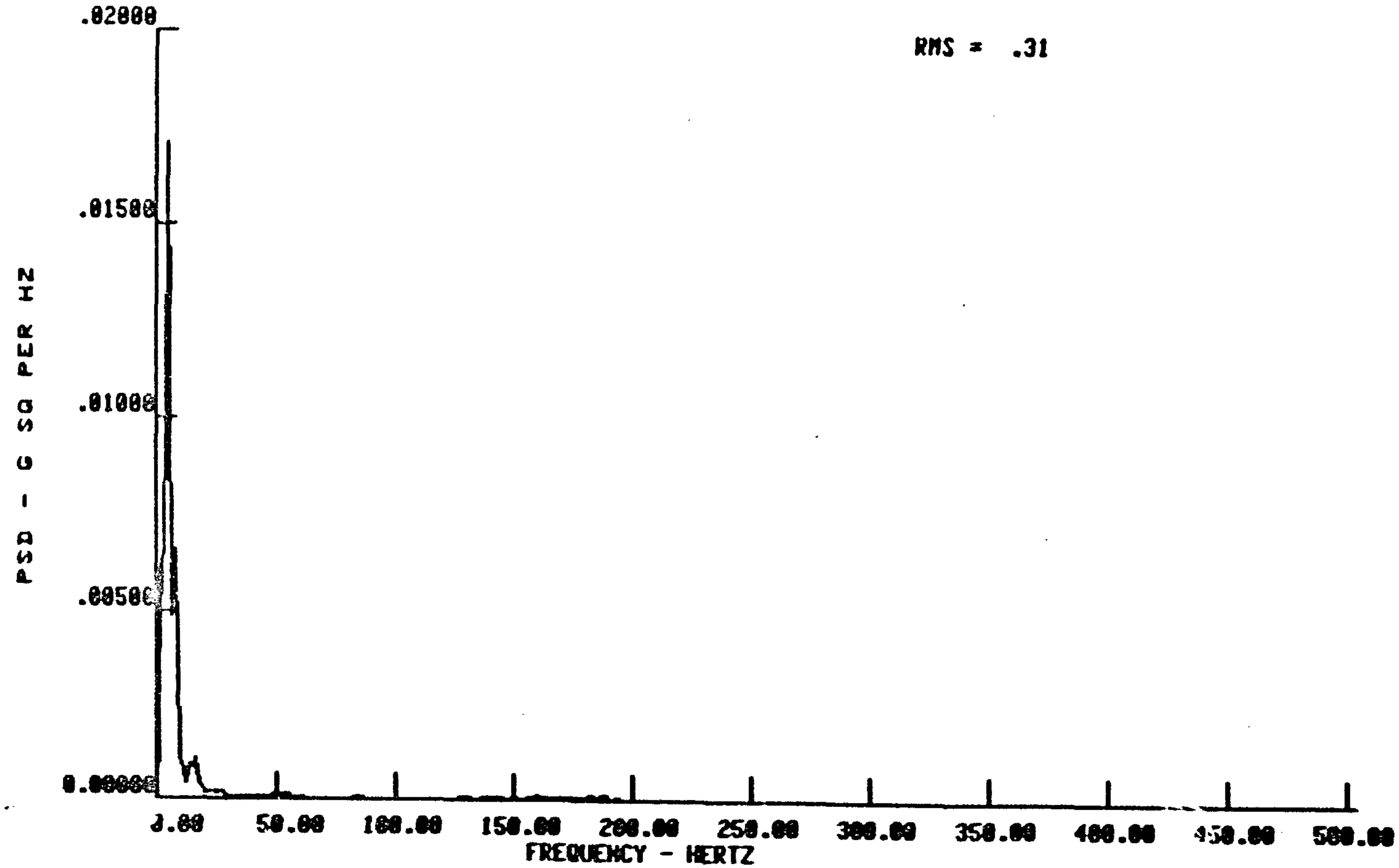

RUN 014 (V) COMPRESSOR BOTTOM (AVE)
RMS = .11
.00400
.00300
.00200
.00100
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

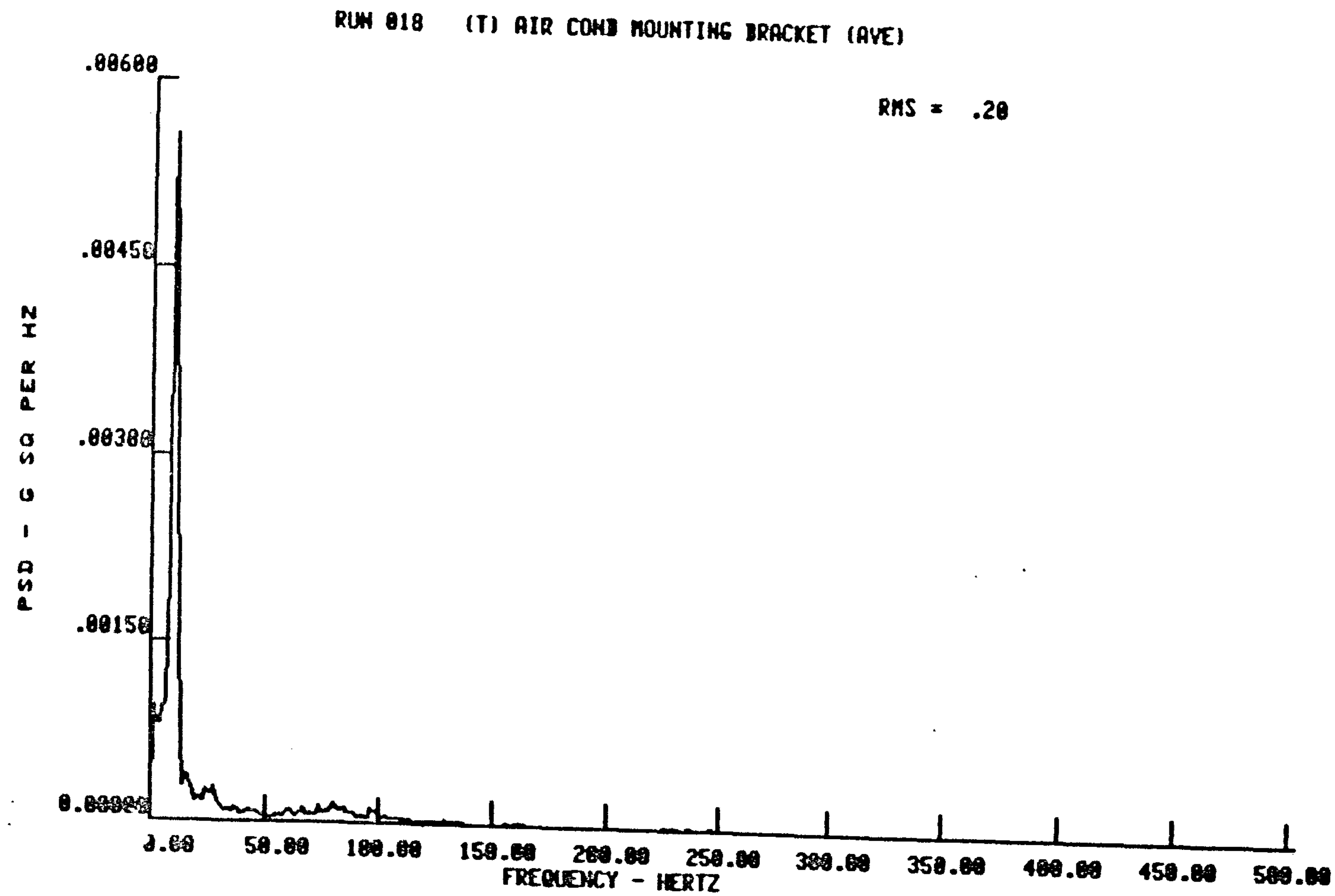

RUN 014 (T) COMPRESSOR BOTTOM (AVE)
RMS = .07
.00040
.00030
.00020
.00010
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ



RUN 016 (L) AIR COND MOUNTING BRACKET (AVE)
RMS = .11
.00400
.00300
.00200
.00100
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

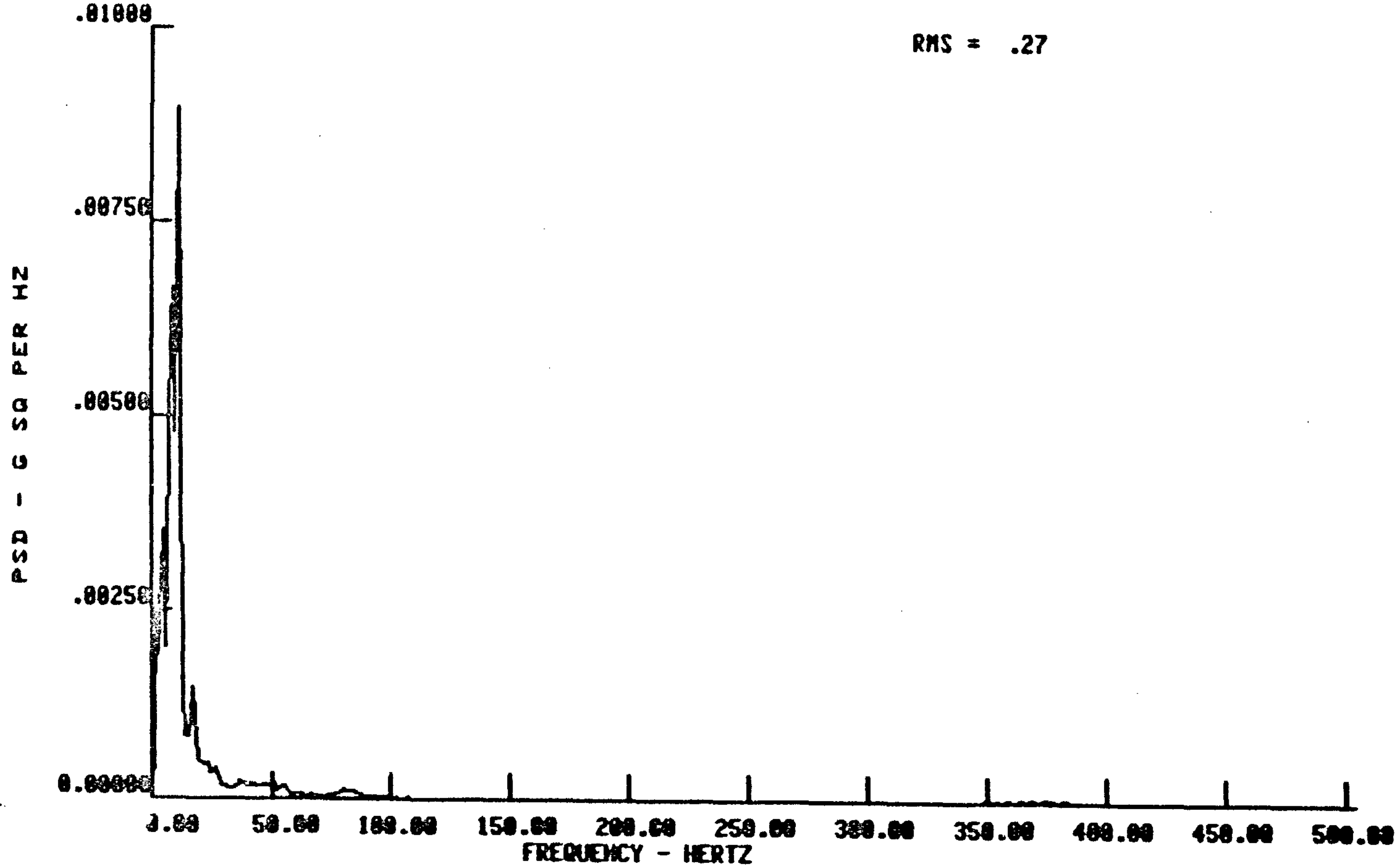
RUN 018 (V) AIR COND MOUNTING BRACKET (AVE)

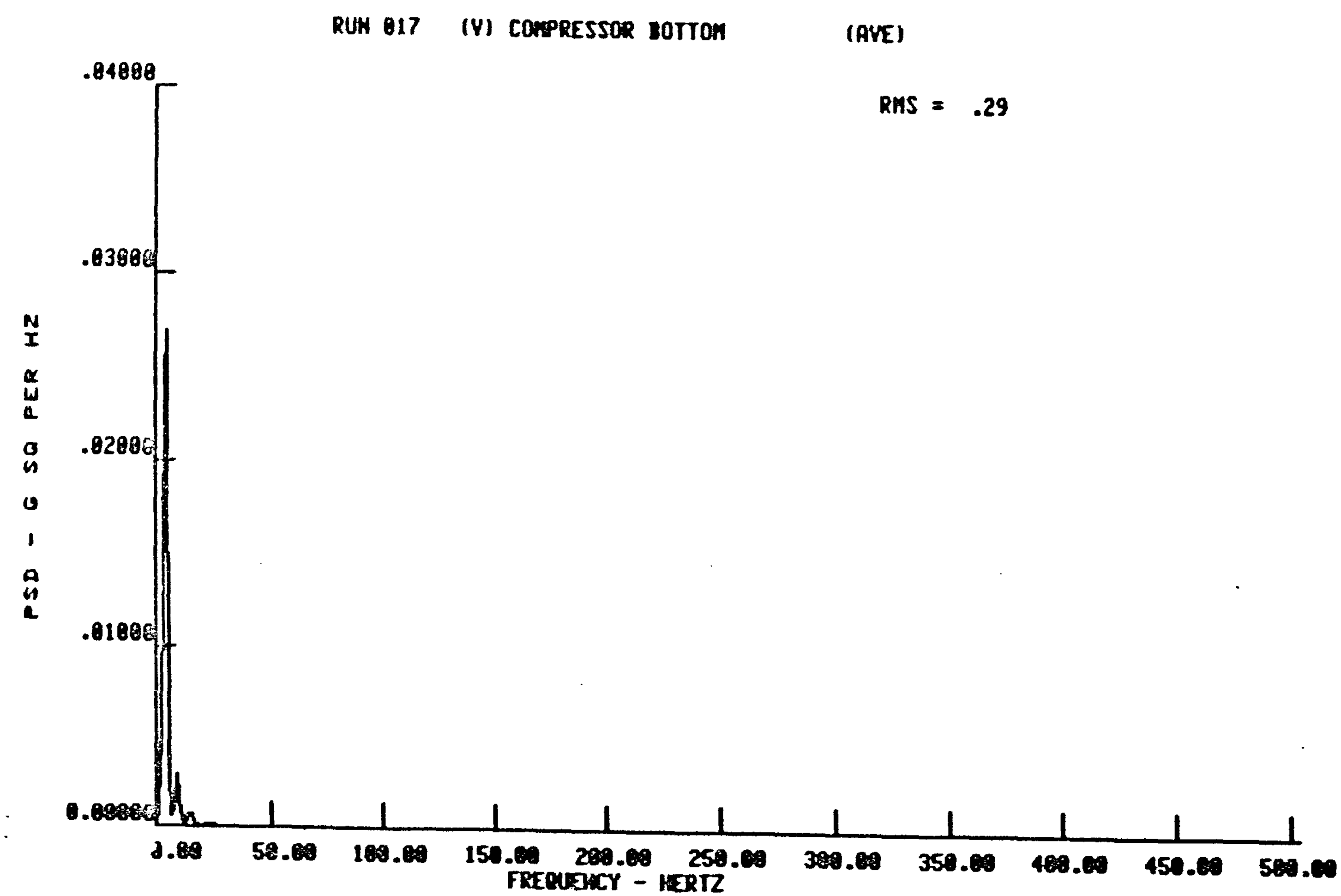




RUN 018 (T) AIR COND MOUNTING BRACKET (AVE)
RMS = .20
PSD - G SQ PER HZ
.00600
.00450
.00300
.00150
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

RUN 016 (L) AIR COND MOUNTING BRACKET (AVE)

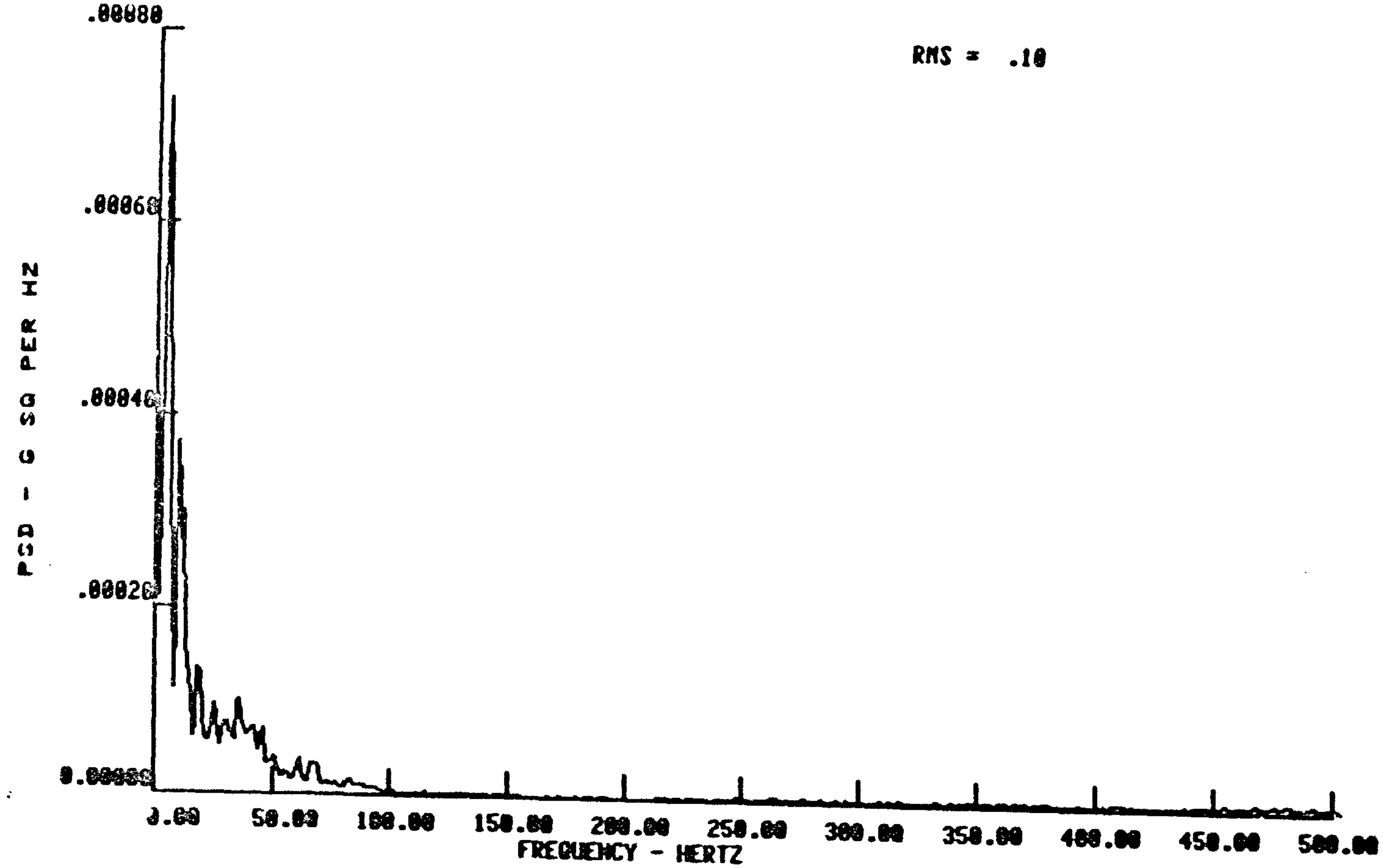




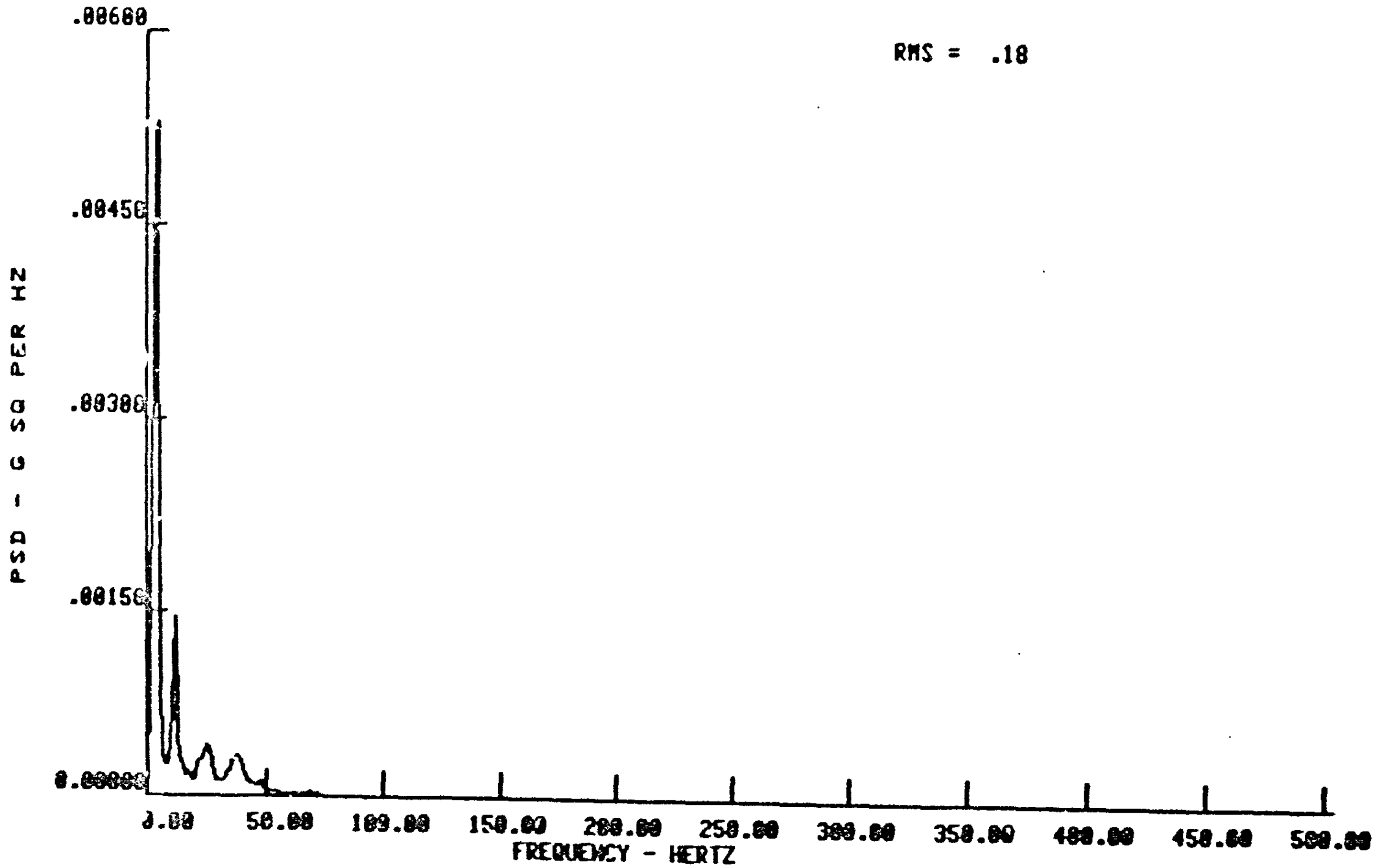
RUN 017 (V) COMPRESSOR BOTTOM (AVE)
RMS = .29
PSD - G SQ PER HZ
.04000
.03000
.02000
.01000
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

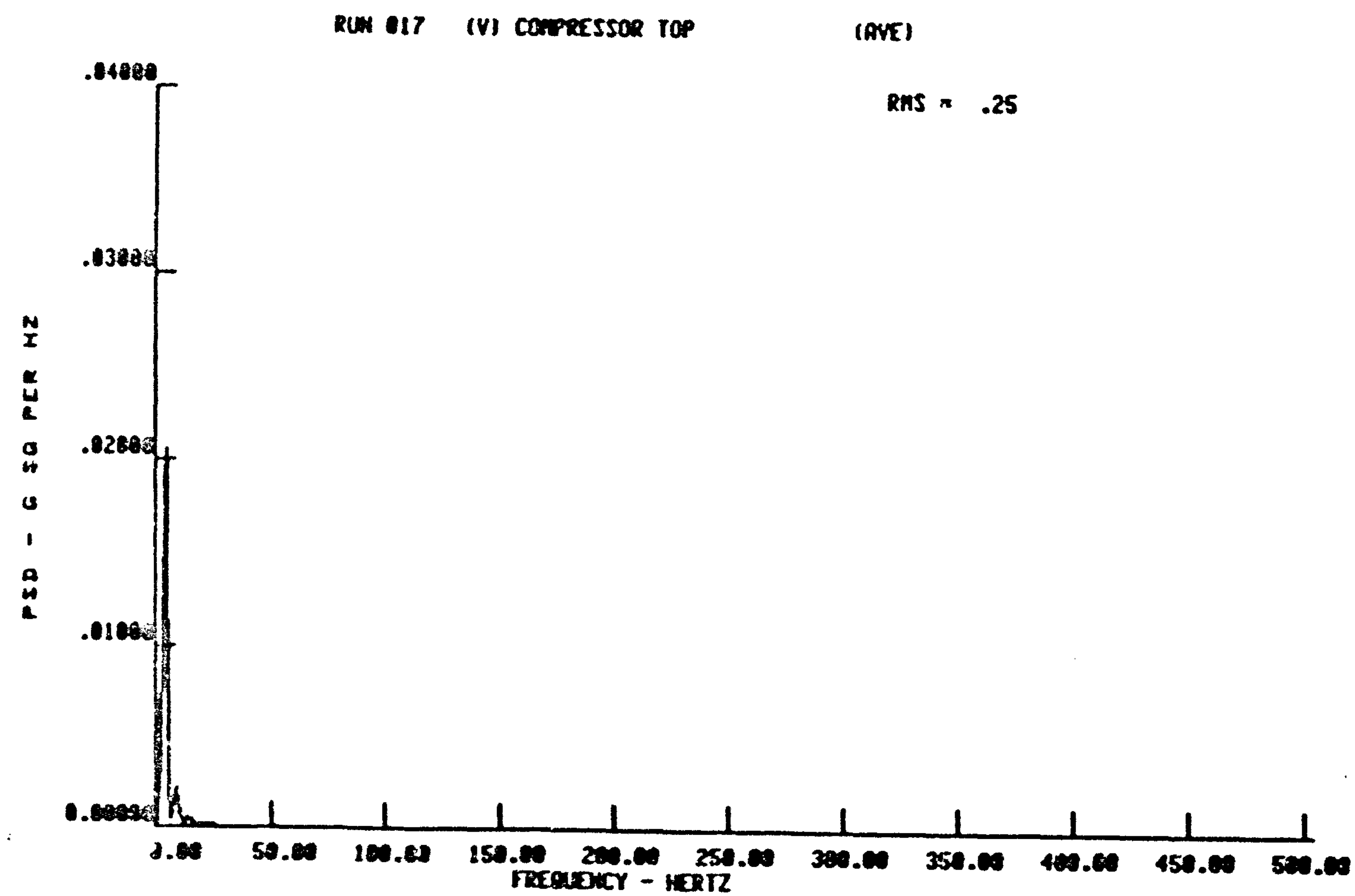
RUN 017 (T) COMPRESSOR BOTTOM (AVE)

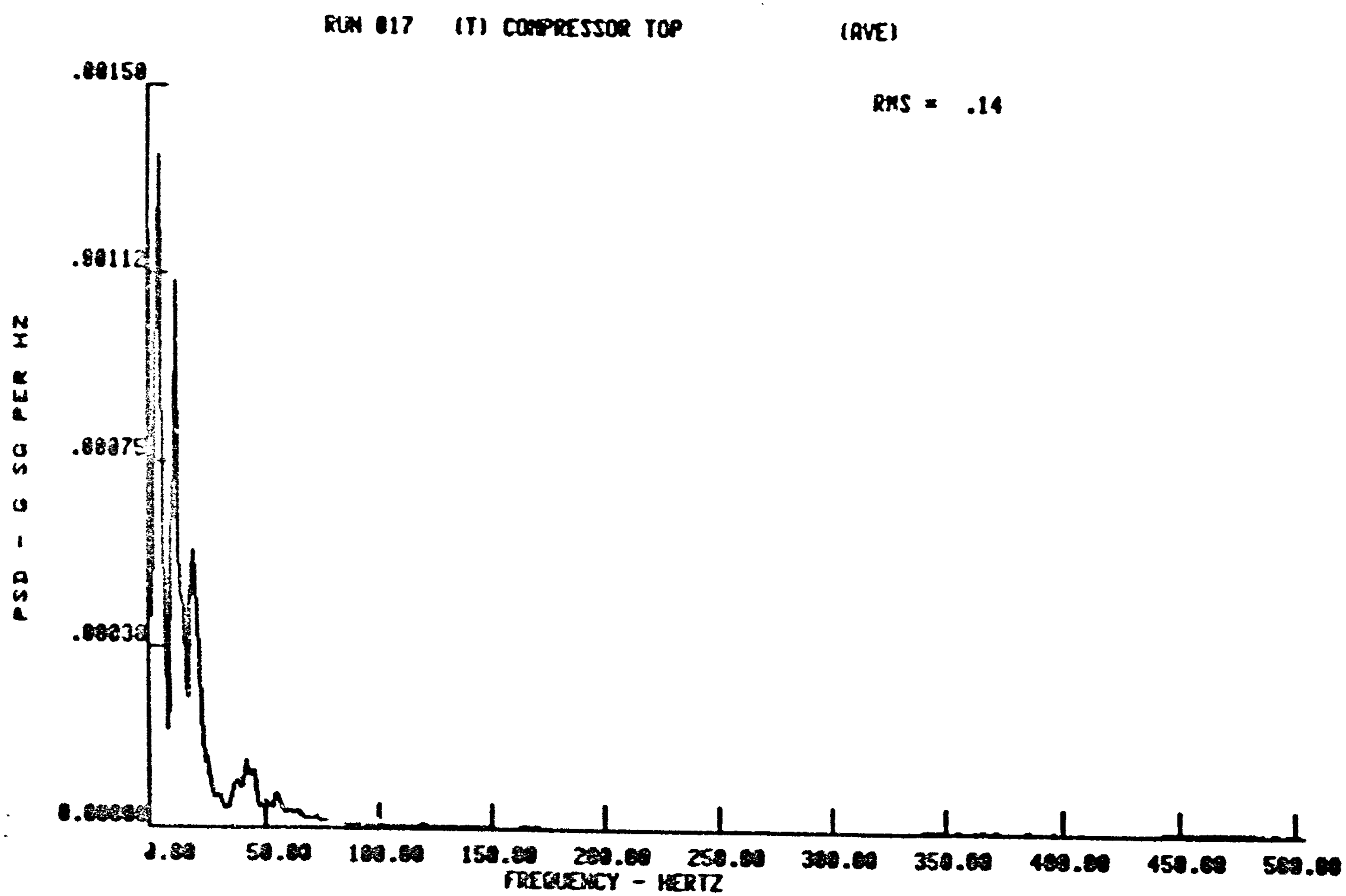
RMS = .10

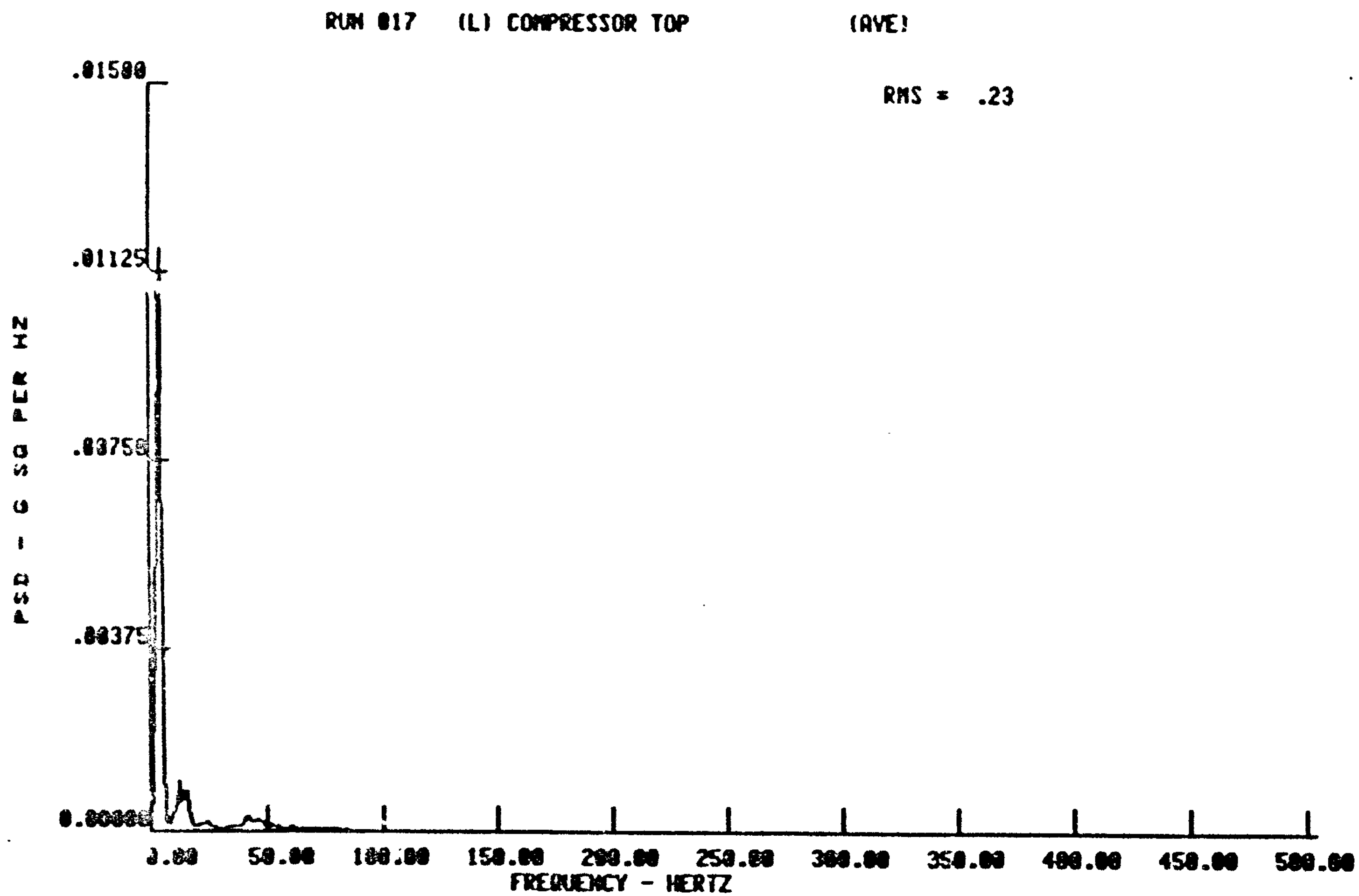


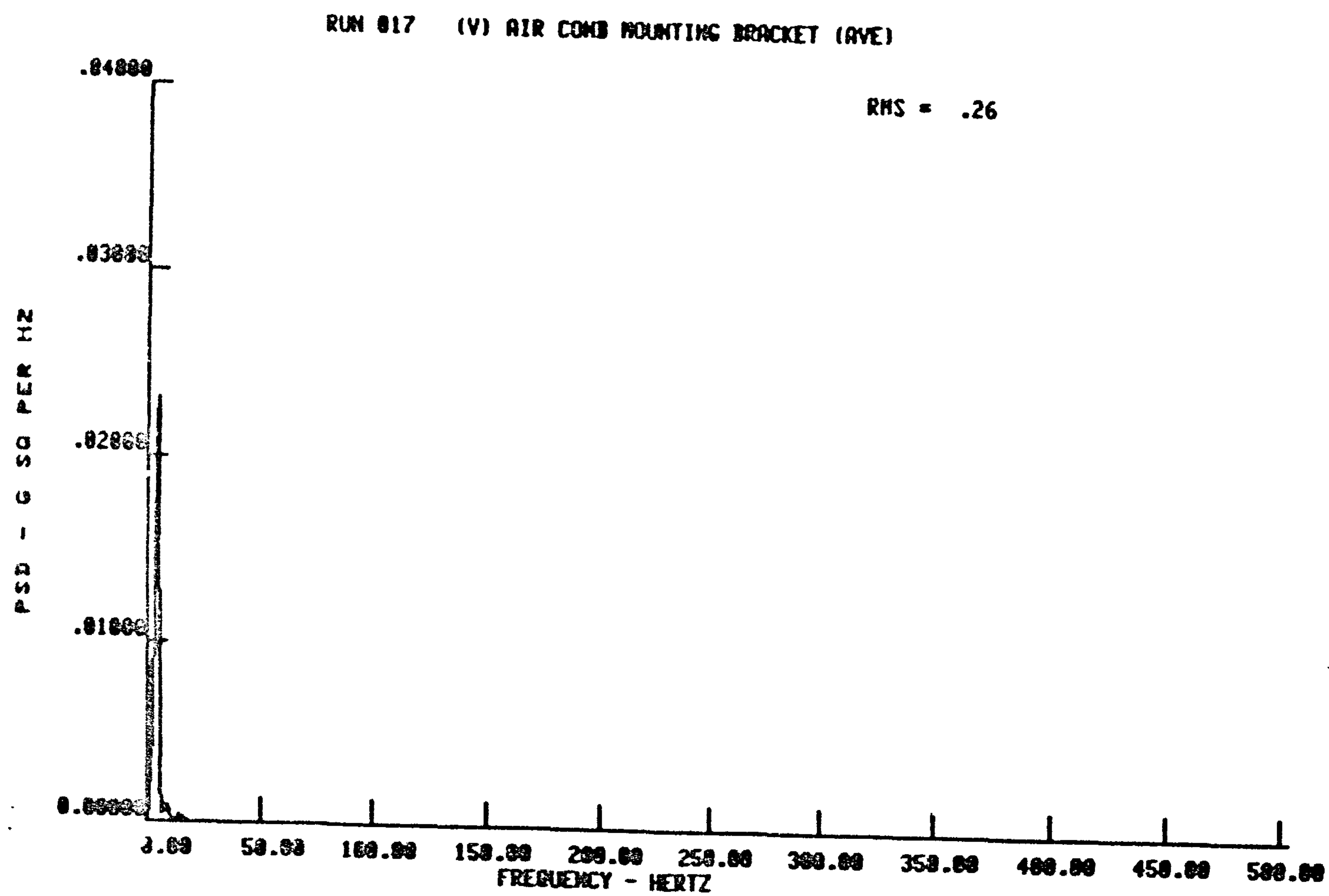
RUN 017 (L) COMPRESSOR BOTTOM (AVE)

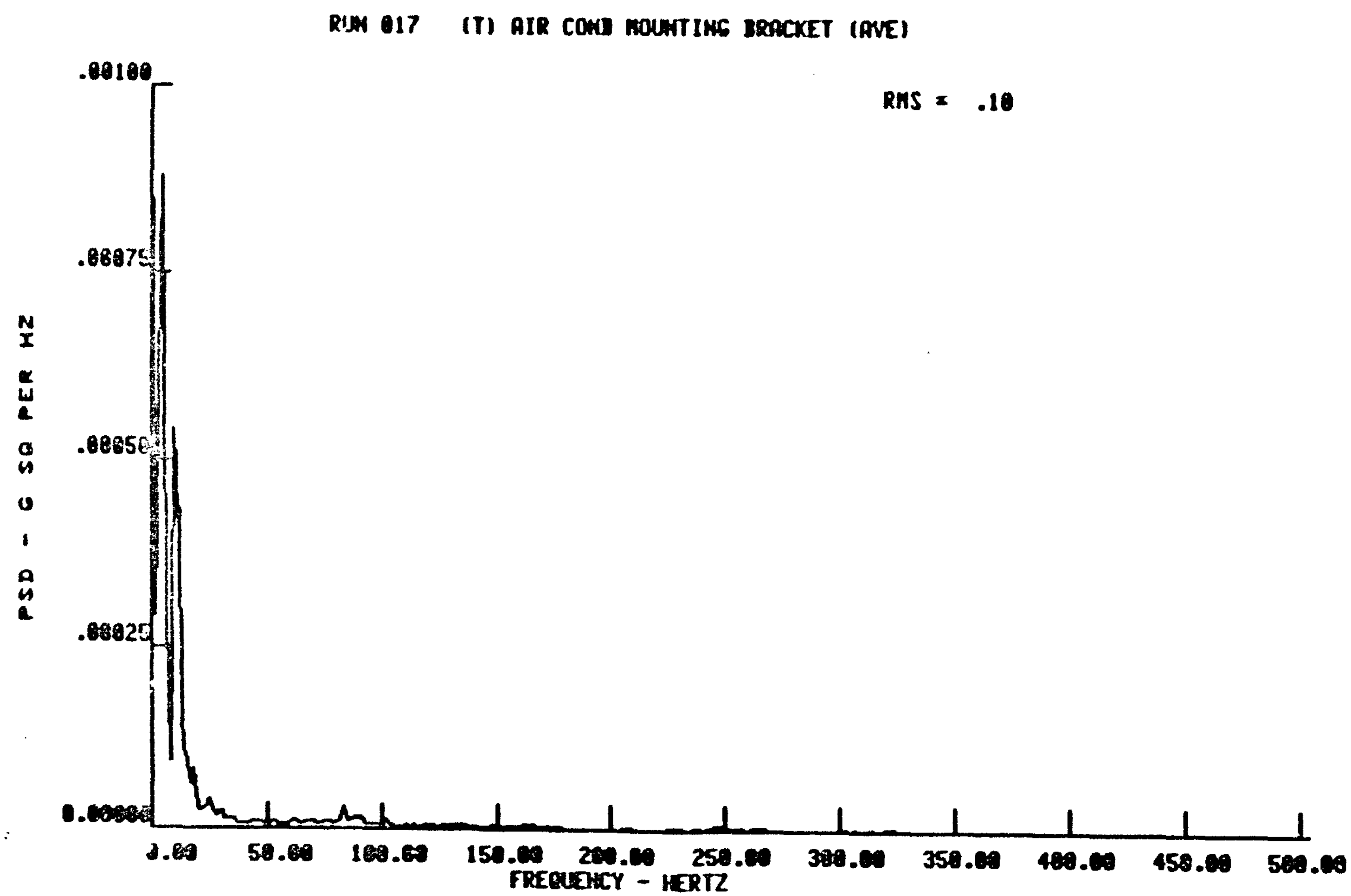



RUN 017 (V) COMPRESSOR TOP (AVE)
RMS = .25
.04000
.03000
.02000
.01000
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

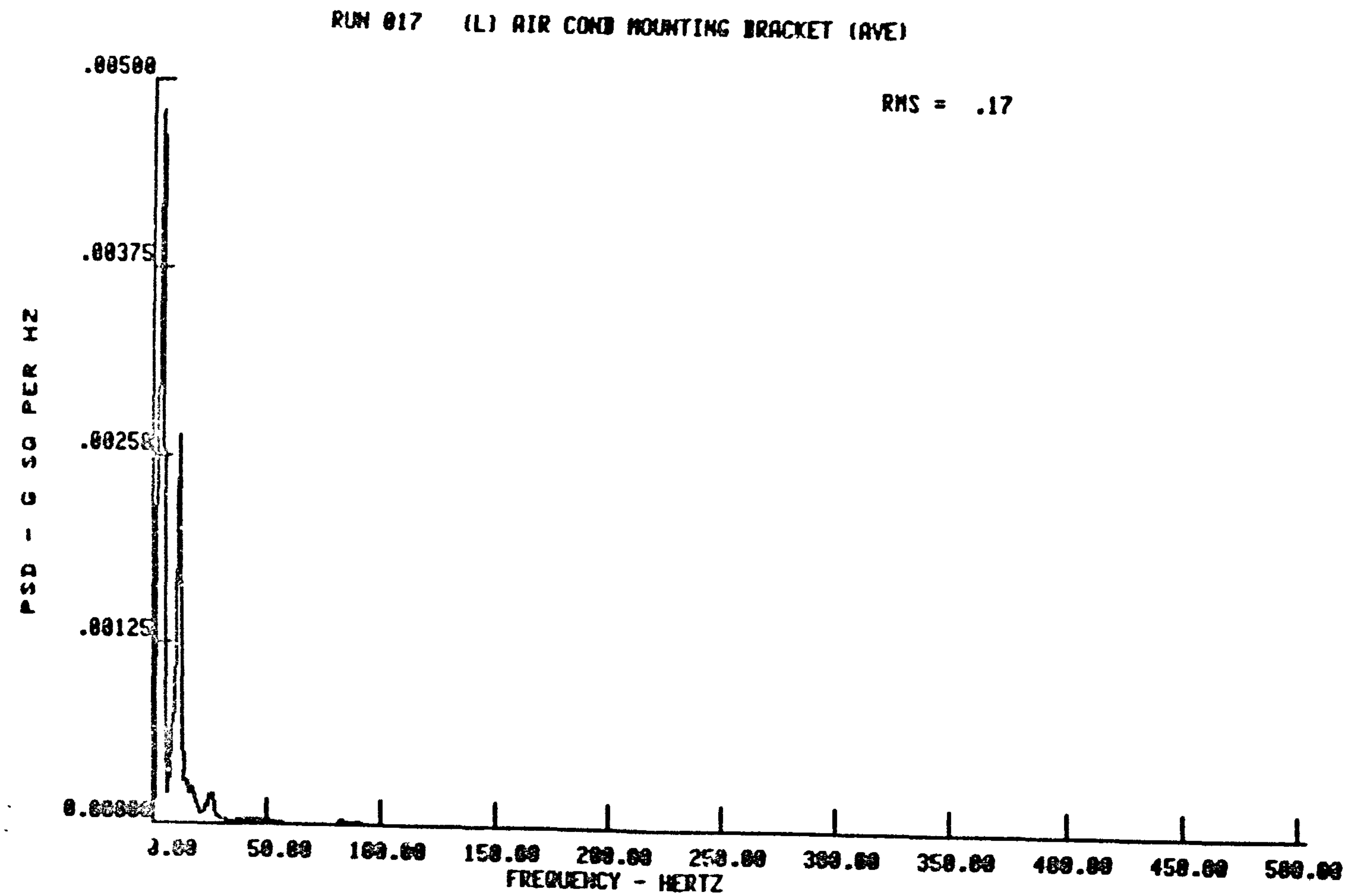

RUN 017 (T) COMPRESSOR TOP (AVE)
RMS = .14
.00150
.00112
.00075
.00038
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

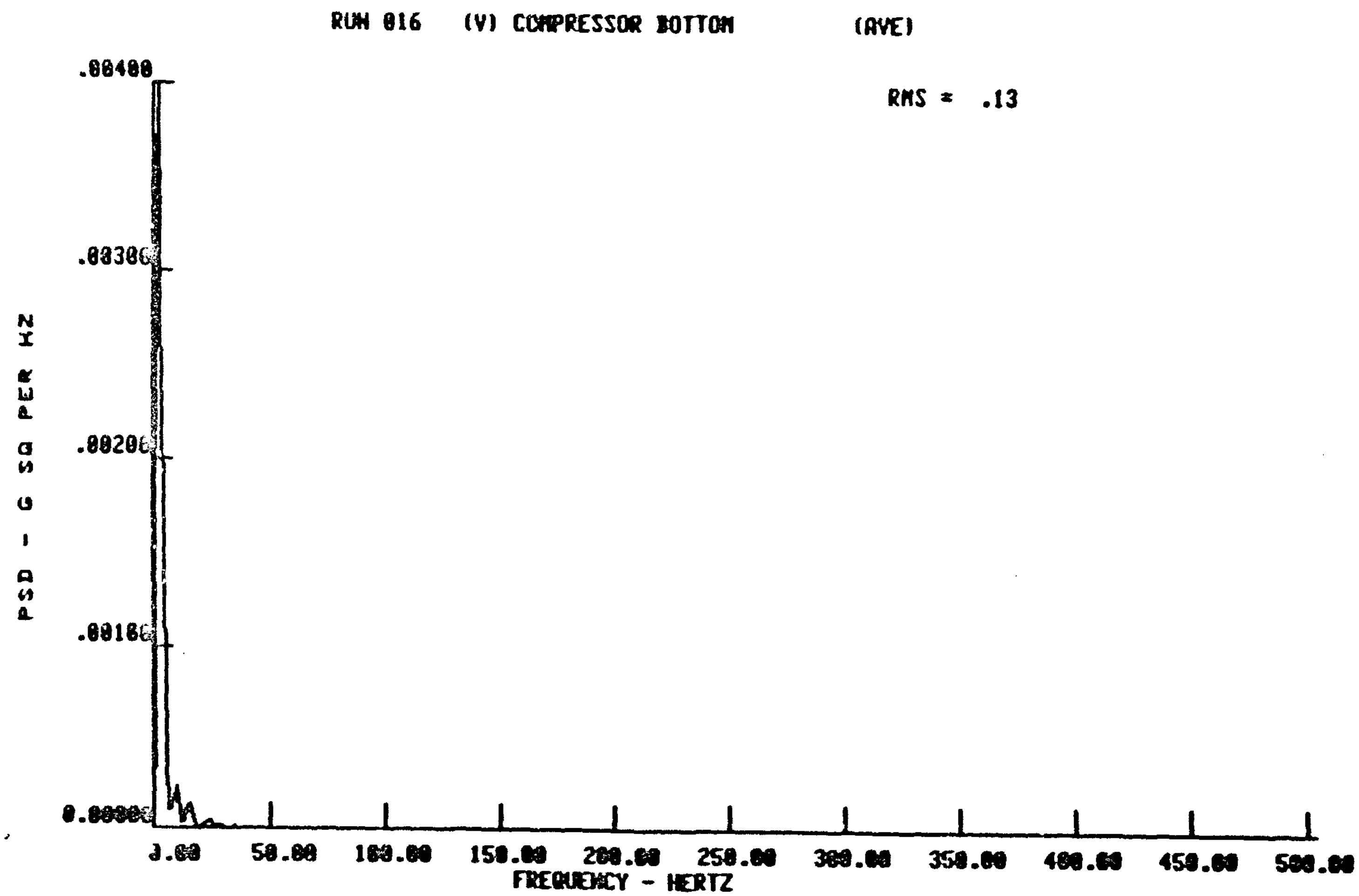

RUN 017 (L) COMPRESSOR TOP (AVE)
RMS = .23
.01500
.01125
.00750
.00375
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

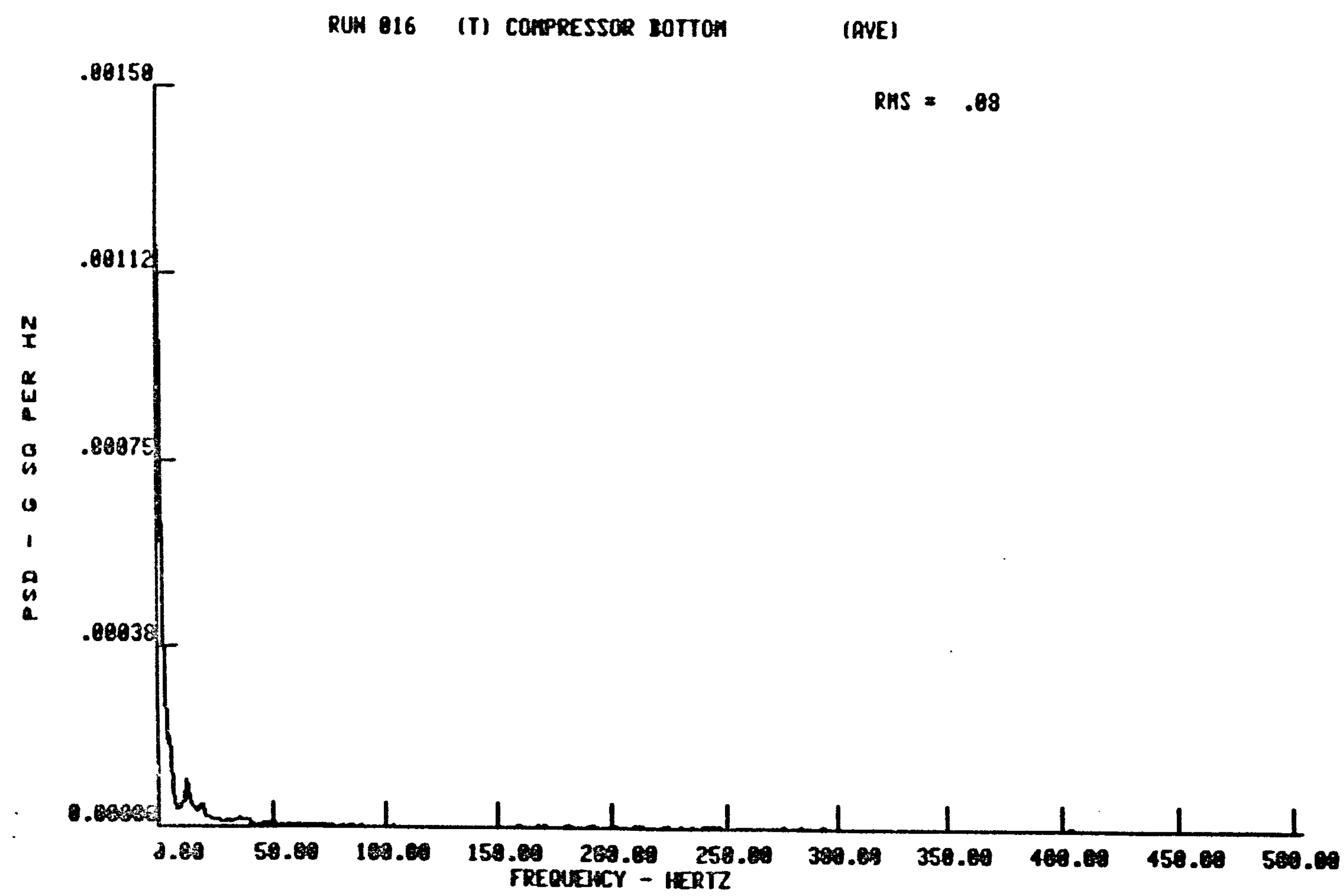

RUN 017 (V) AIR COND MOUNTING BRACKET (AVE)
RMS = .26
.04000
.03000
.02000
.01000
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ



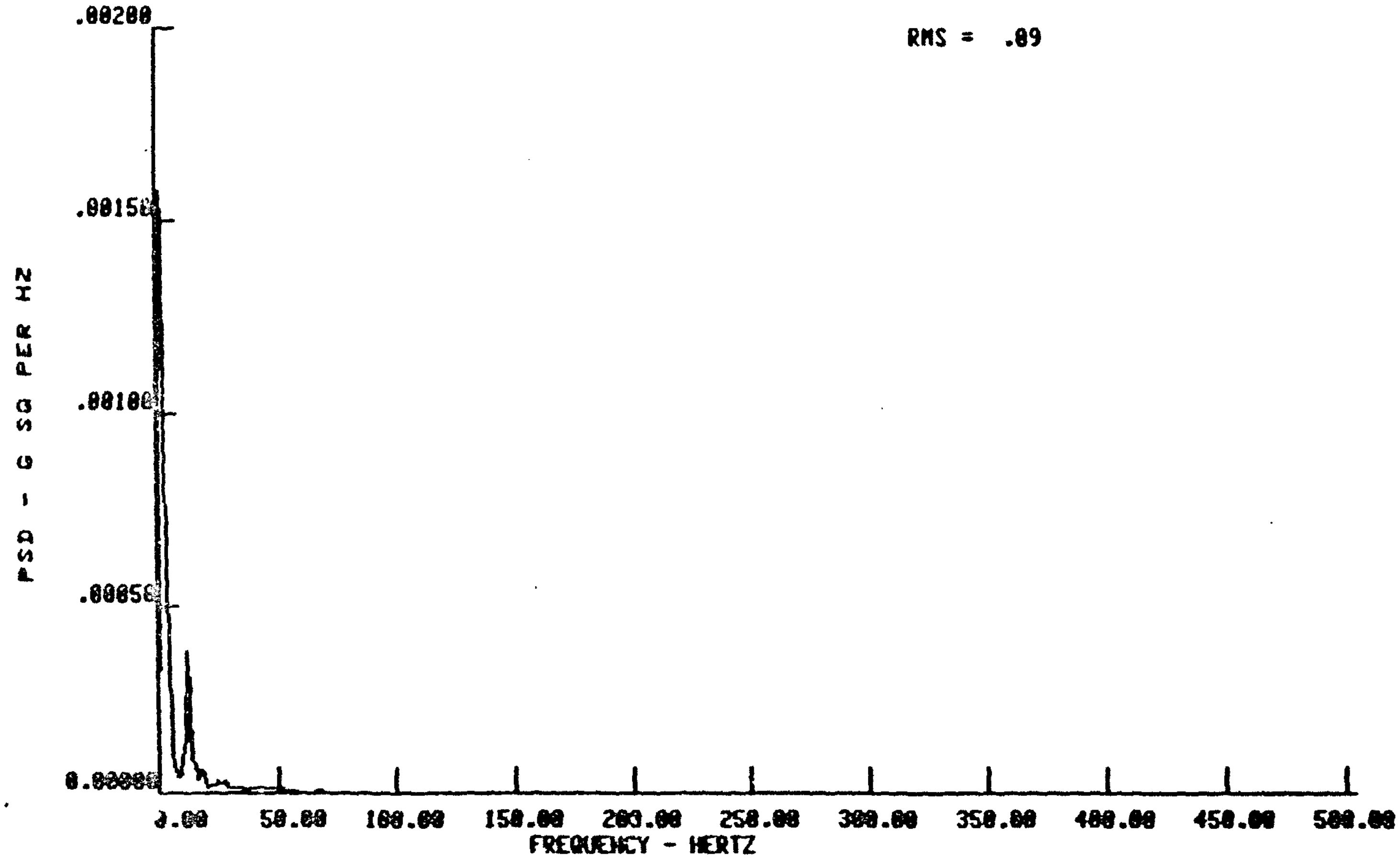
RUN 017 (T) AIR COND MOUNTING BRACKET (AVE)
RMS = .10
.00100
.00075
.00050
.00025
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

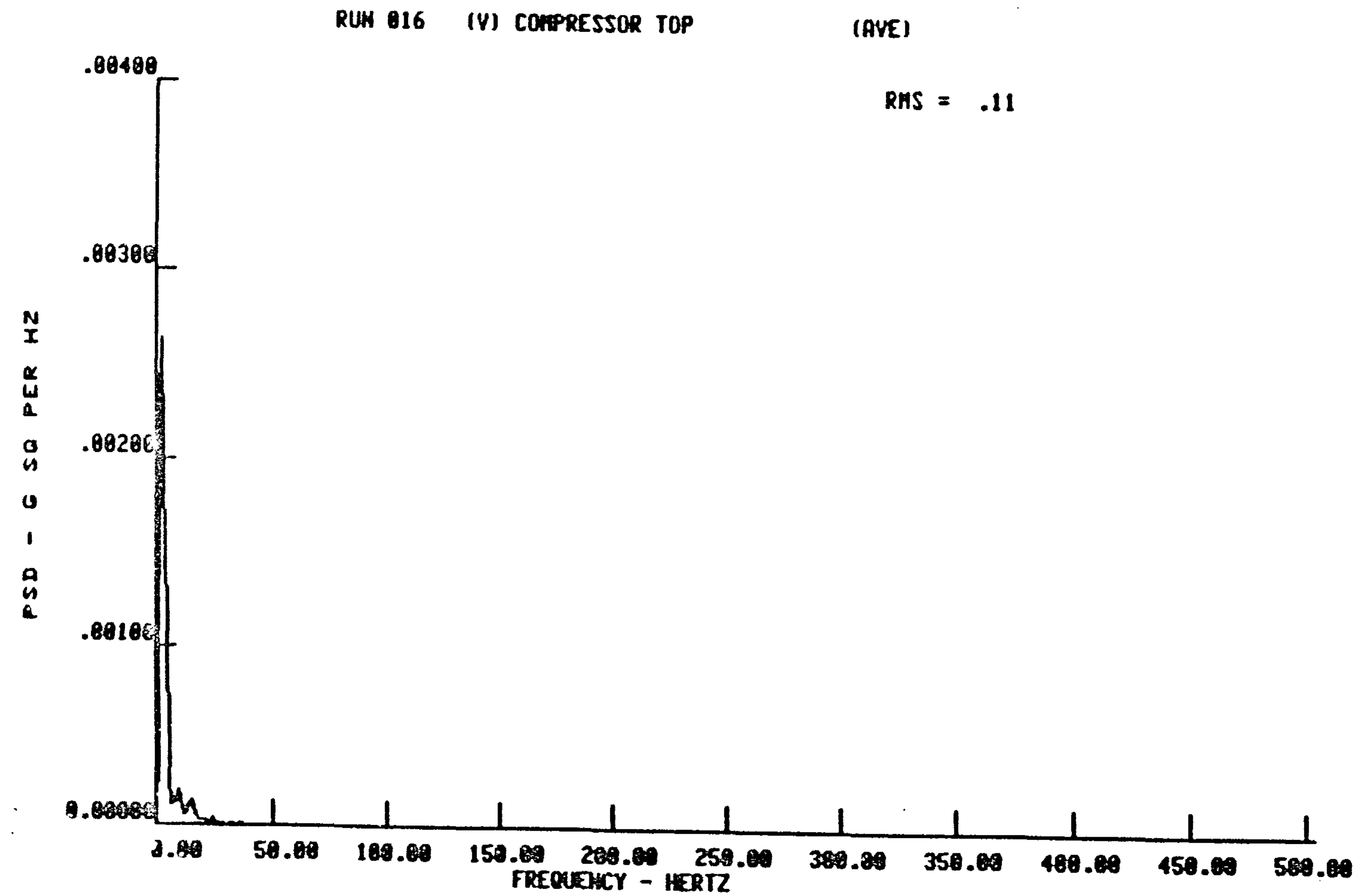

RUN 017 (L) AIR COND MOUNTING BRACKET (AVE)
RMS = .17
.00500
.00375
.00250
.00125
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

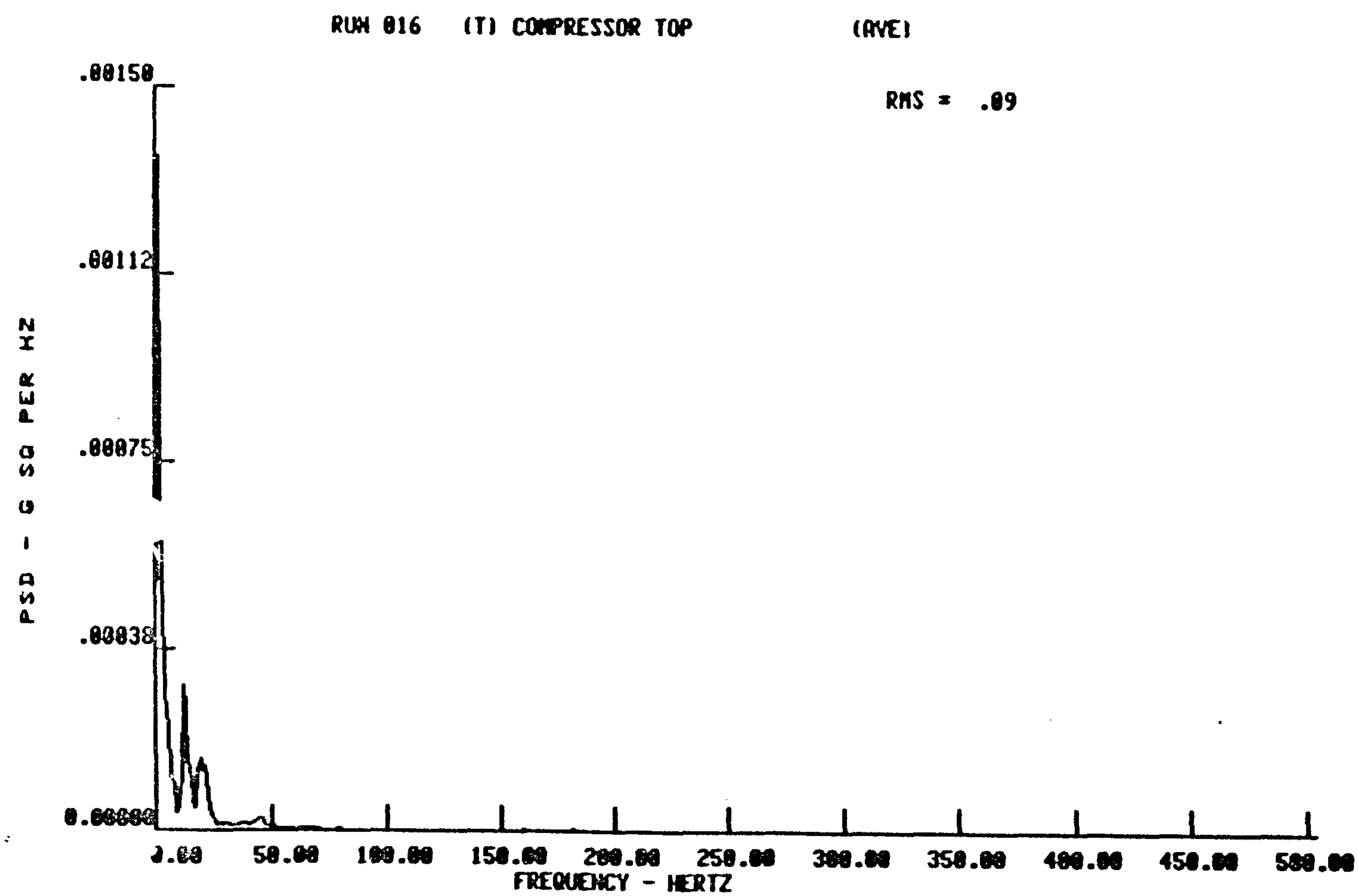

RUN 016 (V) COMPRESSOR BOTTOM (AVE)
RMS = .13
.00400
.00300
.00200
.00100
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

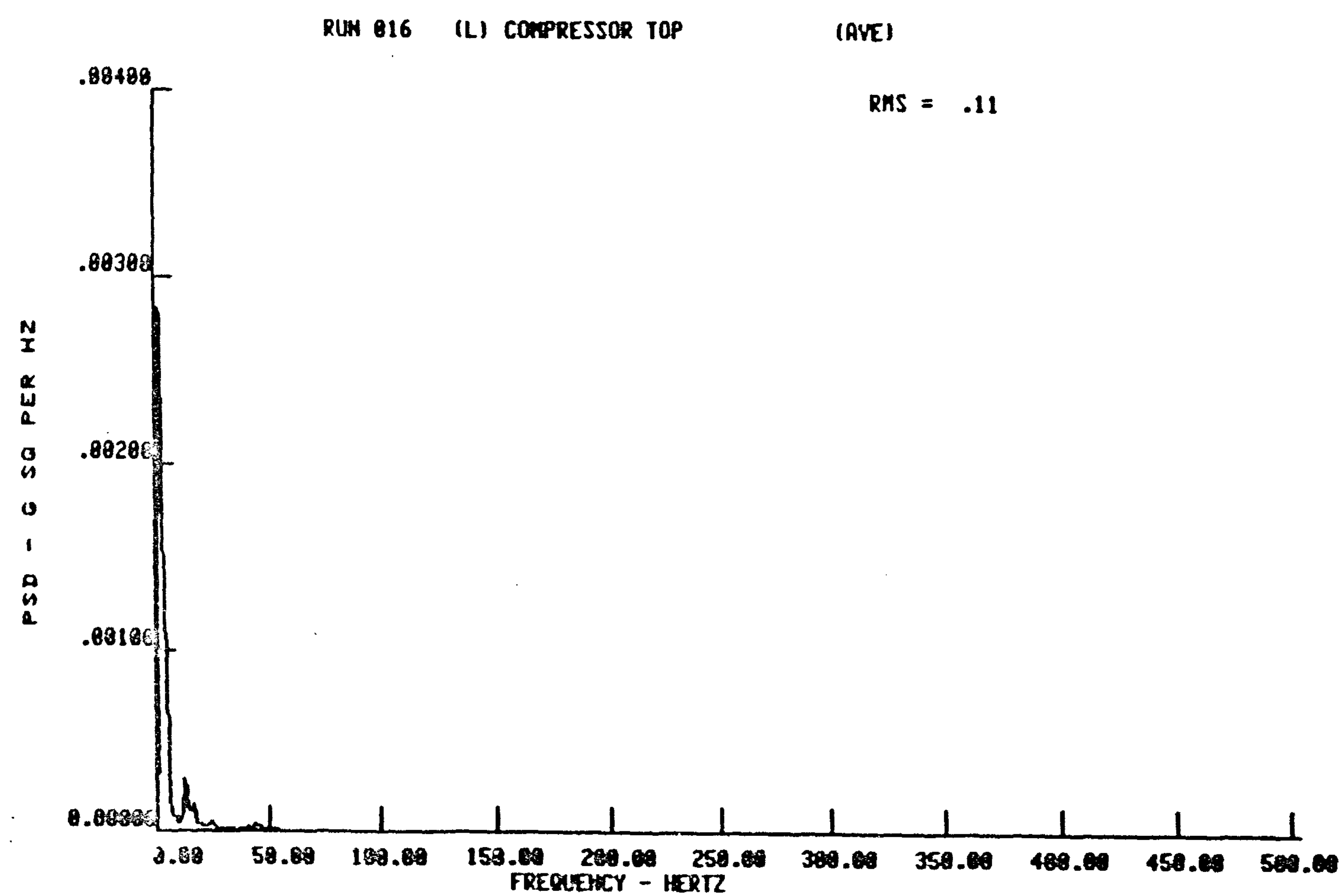

RUN 016 (T) COMPRESSOR BOTTOM (AVE)
RMS = .08
PSD - G SQ PER HZ
.00150
.00112
.00075
.00038
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

RUN 016 (L) COMPRESSOR BOTTOM (AVE)

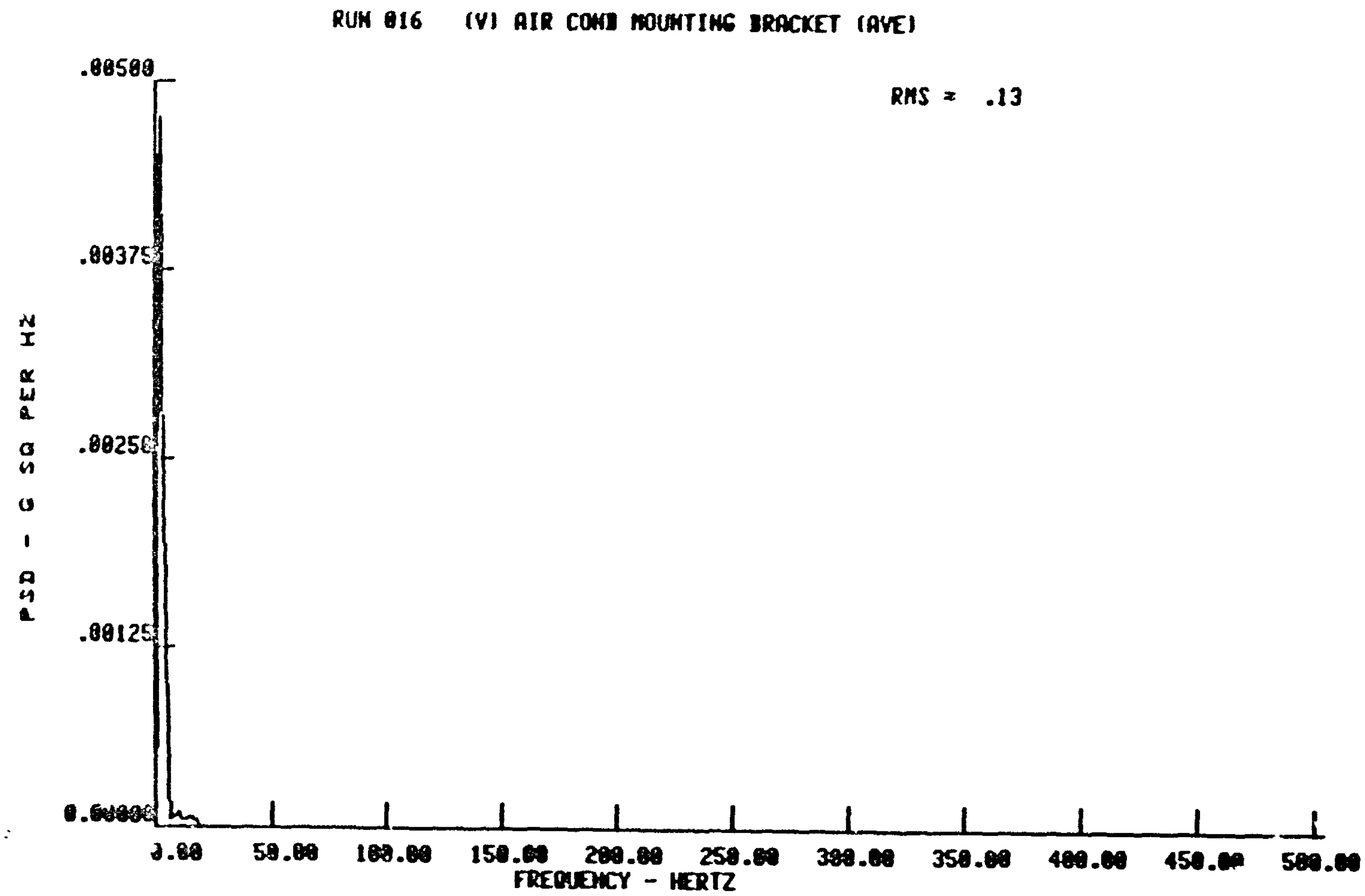


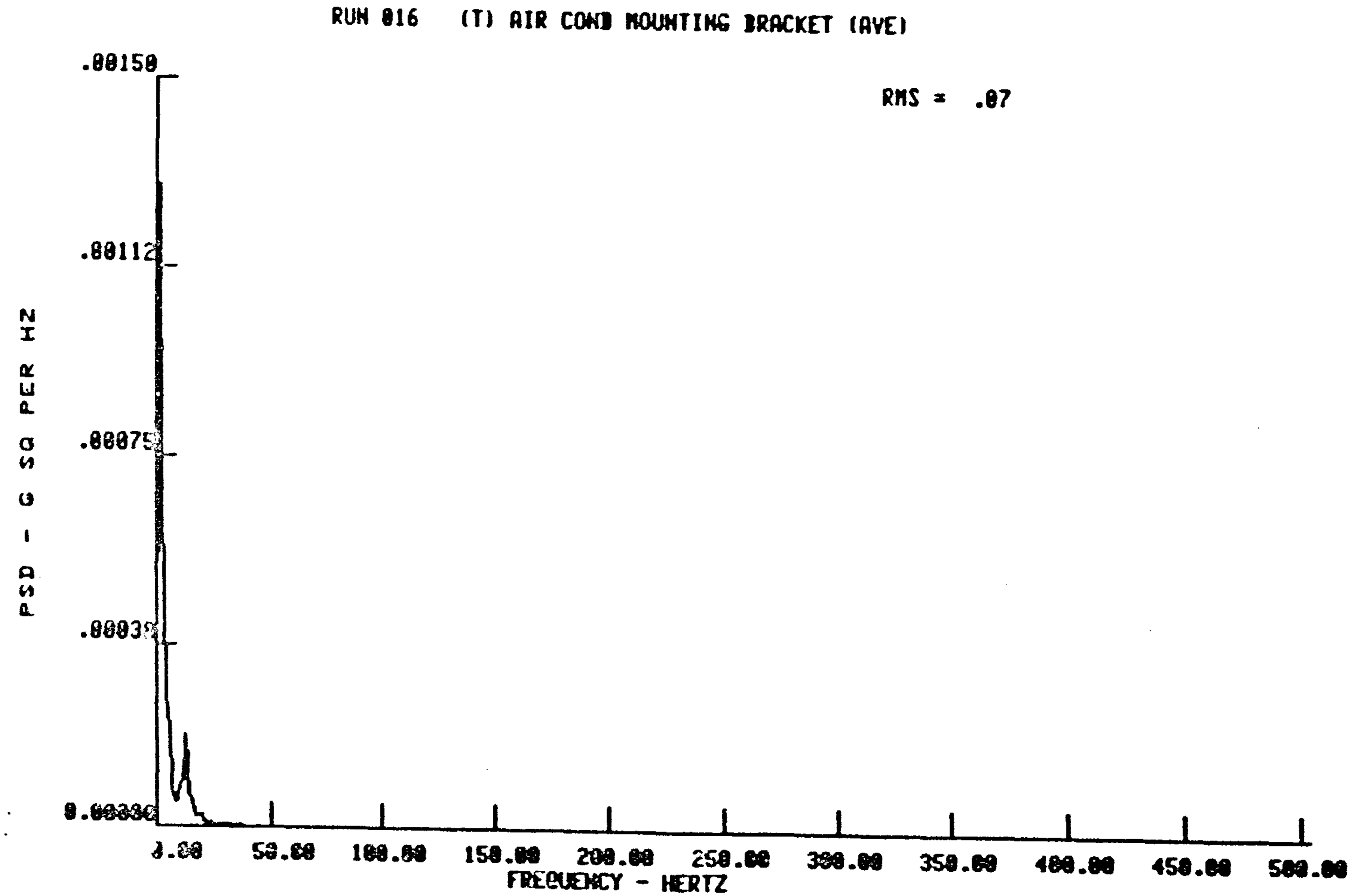

RUN 016 (V) COMPRESSOR TOP (AVE)
RMS = .11
.00400
.00300
.00200
.00100
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ


RUN 016 (T) COMPRESSOR TOP (AVE)
RMS = .09
PSD - G SQ PER HZ
.00150
.00112
.00075
.00038
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ



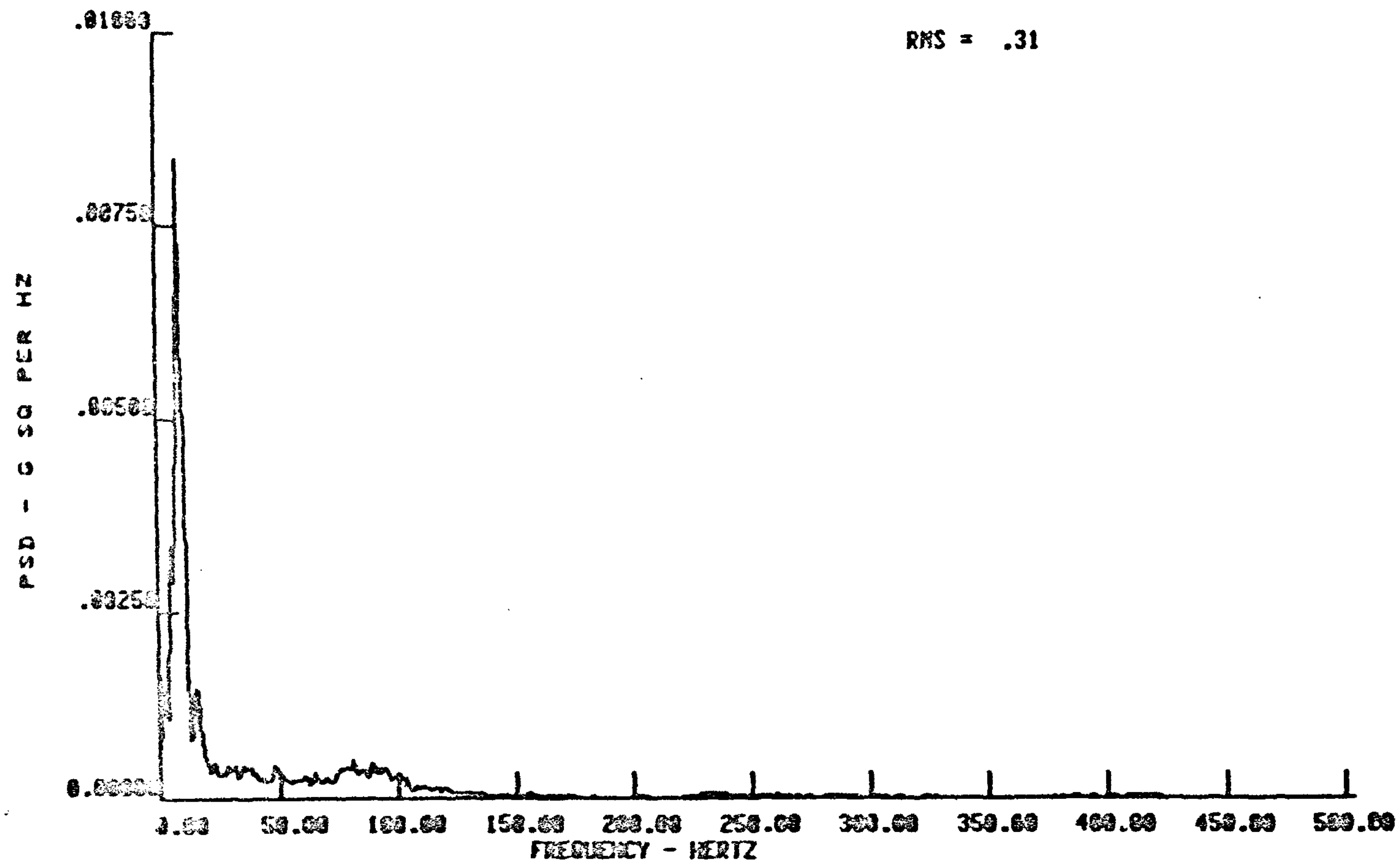
RUN 016 (L) COMPRESSOR TOP (AVE)
RMS = .11
PSD - G SQ PER HZ
.00400
.00300
.00200
.00100
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

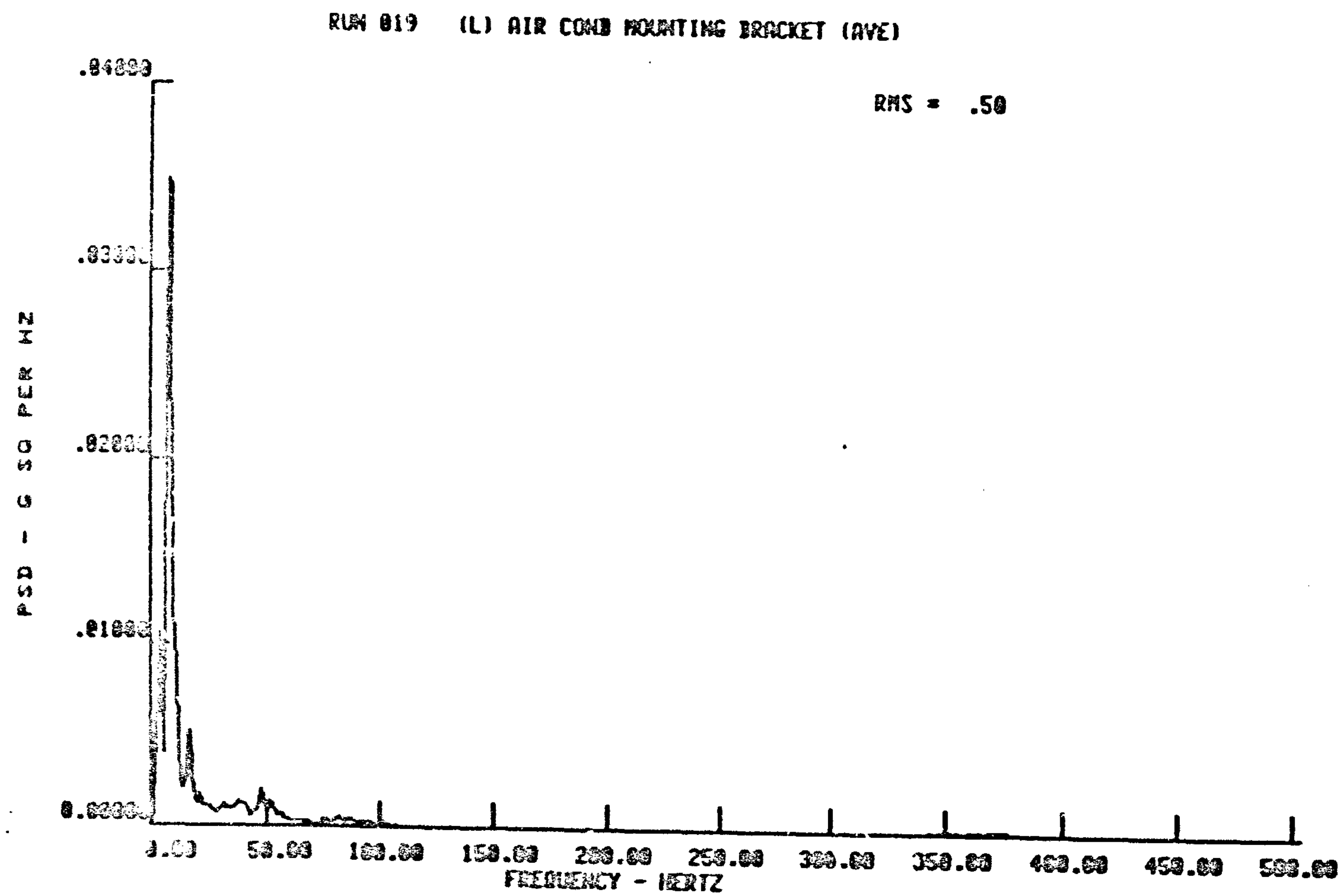

RUN 016 (V) AIR COND MOUNTING BRACKET (AVE)
RMS = .13
PSD - G SQ PER HZ
.00500
.00375
.00250
.00125
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ



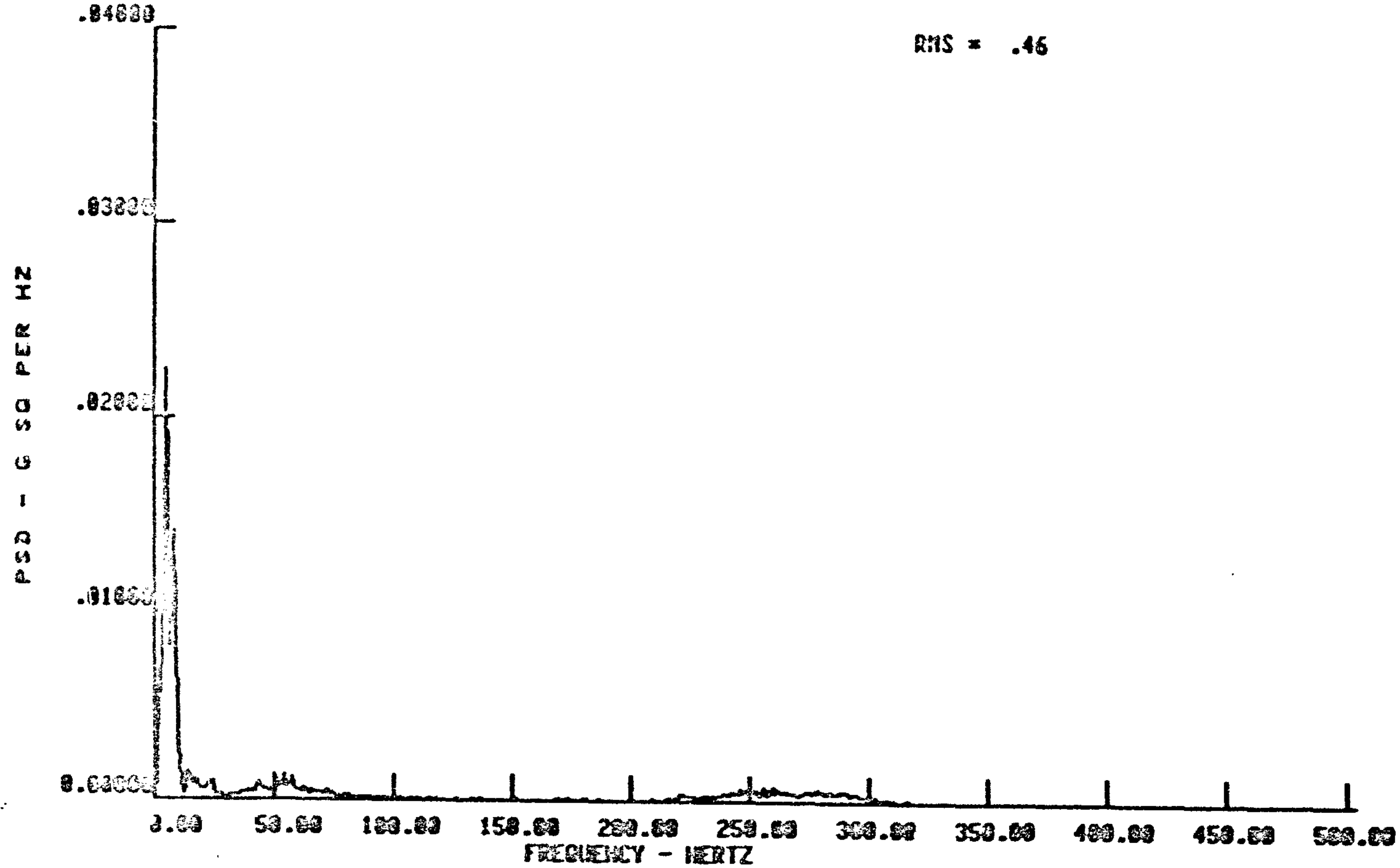
RUN 016 (T) AIR COND MOUNTING BRACKET (AVE)
RMS = .07
.00150
.00112
.00075
.00037
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

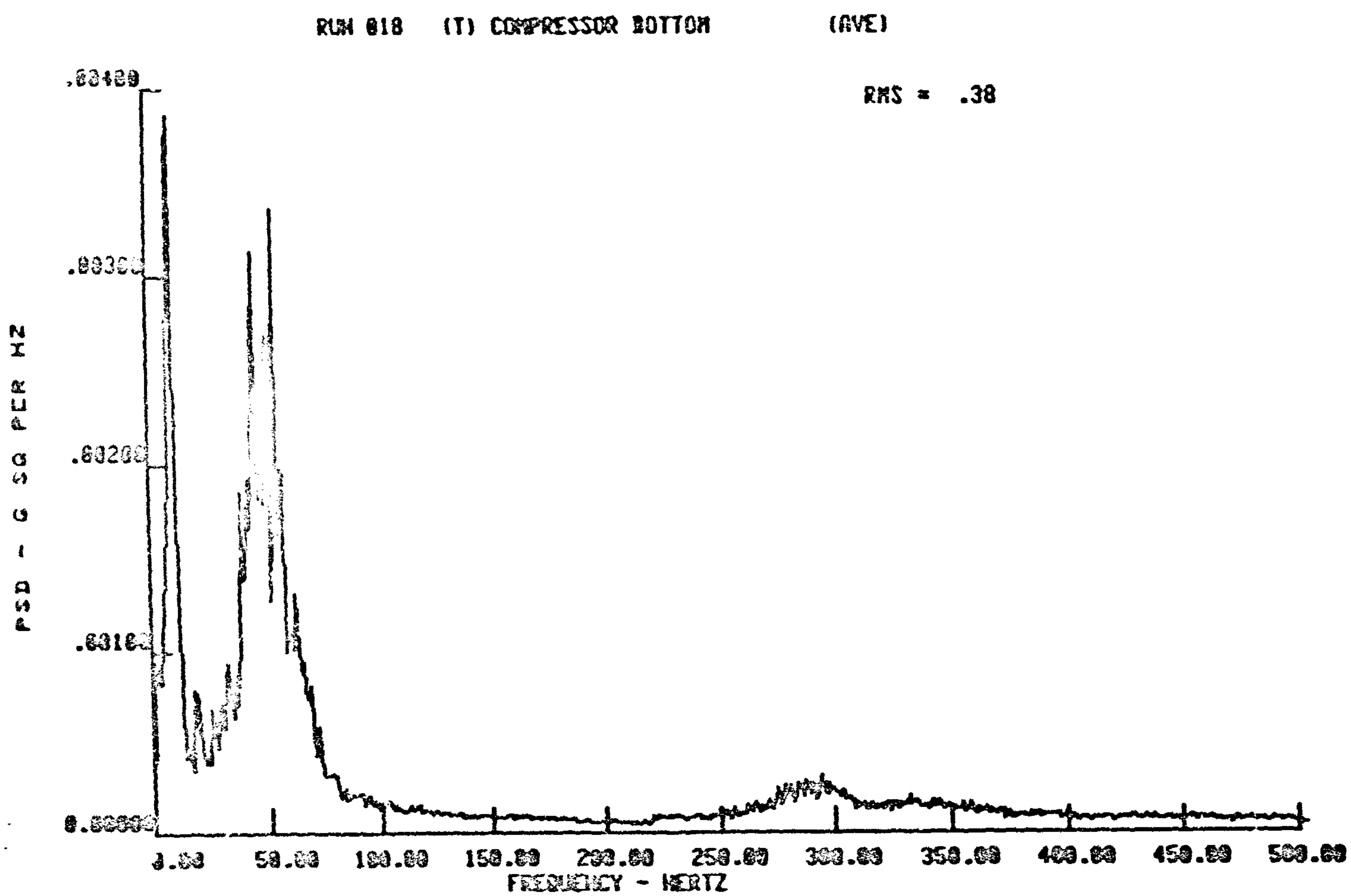
RUN 019 (T) AIR COND MOUNTING BRACKET (AVE)

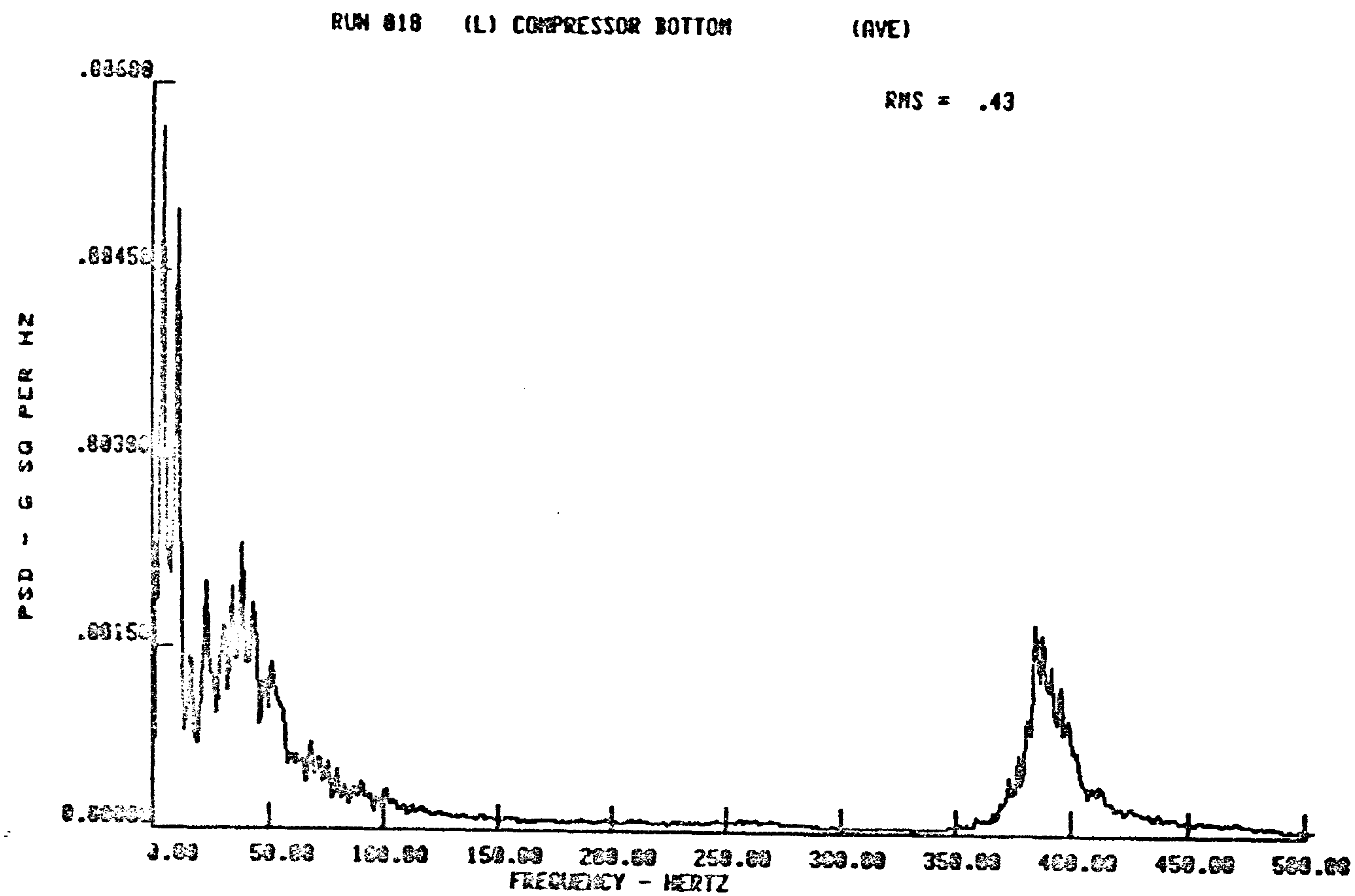


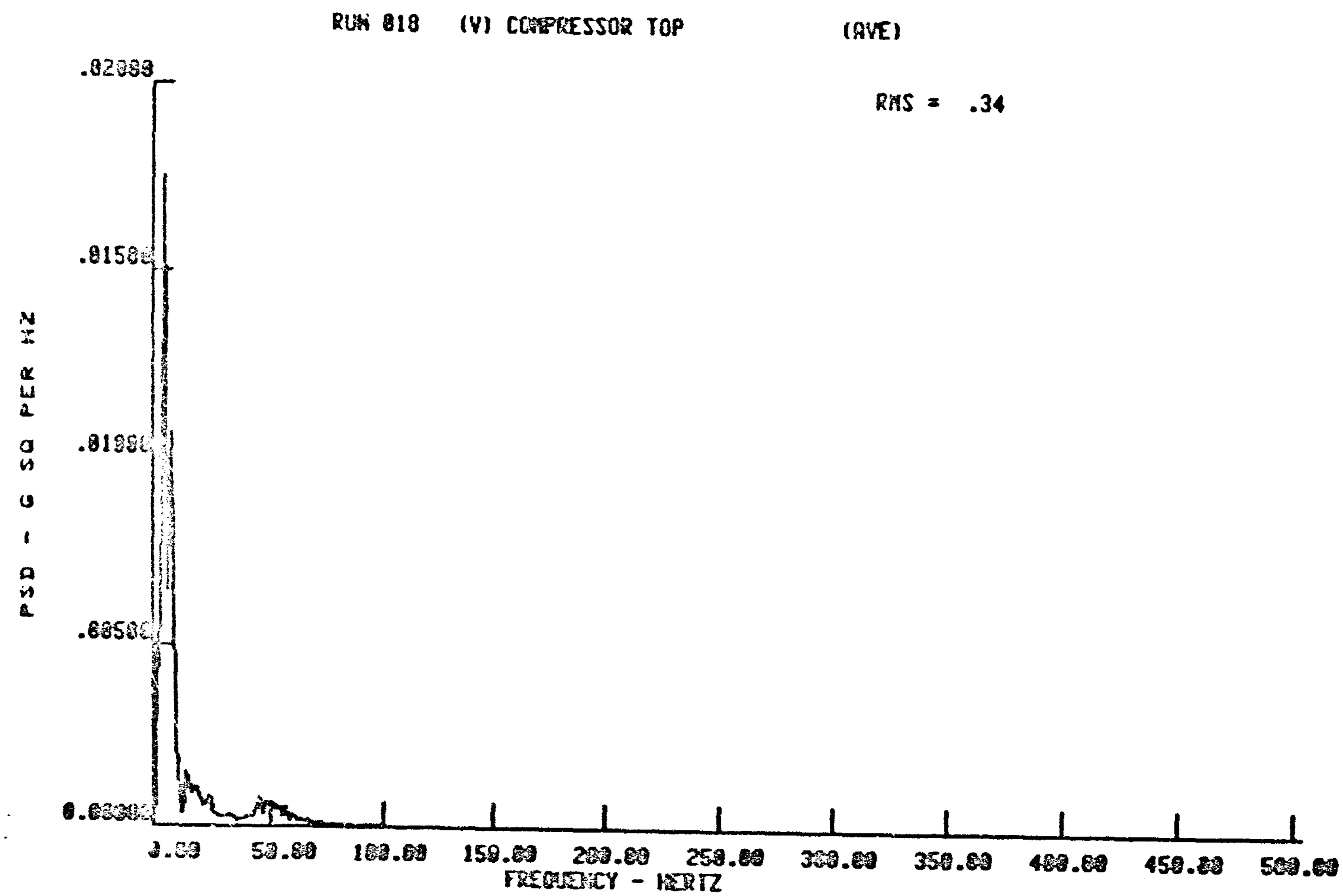

RUN 019 (L) AIR COND MOUNTING BRACKET (AVE)
RMS = .50
.04000
.03000
.02000
.01000
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

RUN 018 (V) COMPRESSOR BOTTOM (AVE)

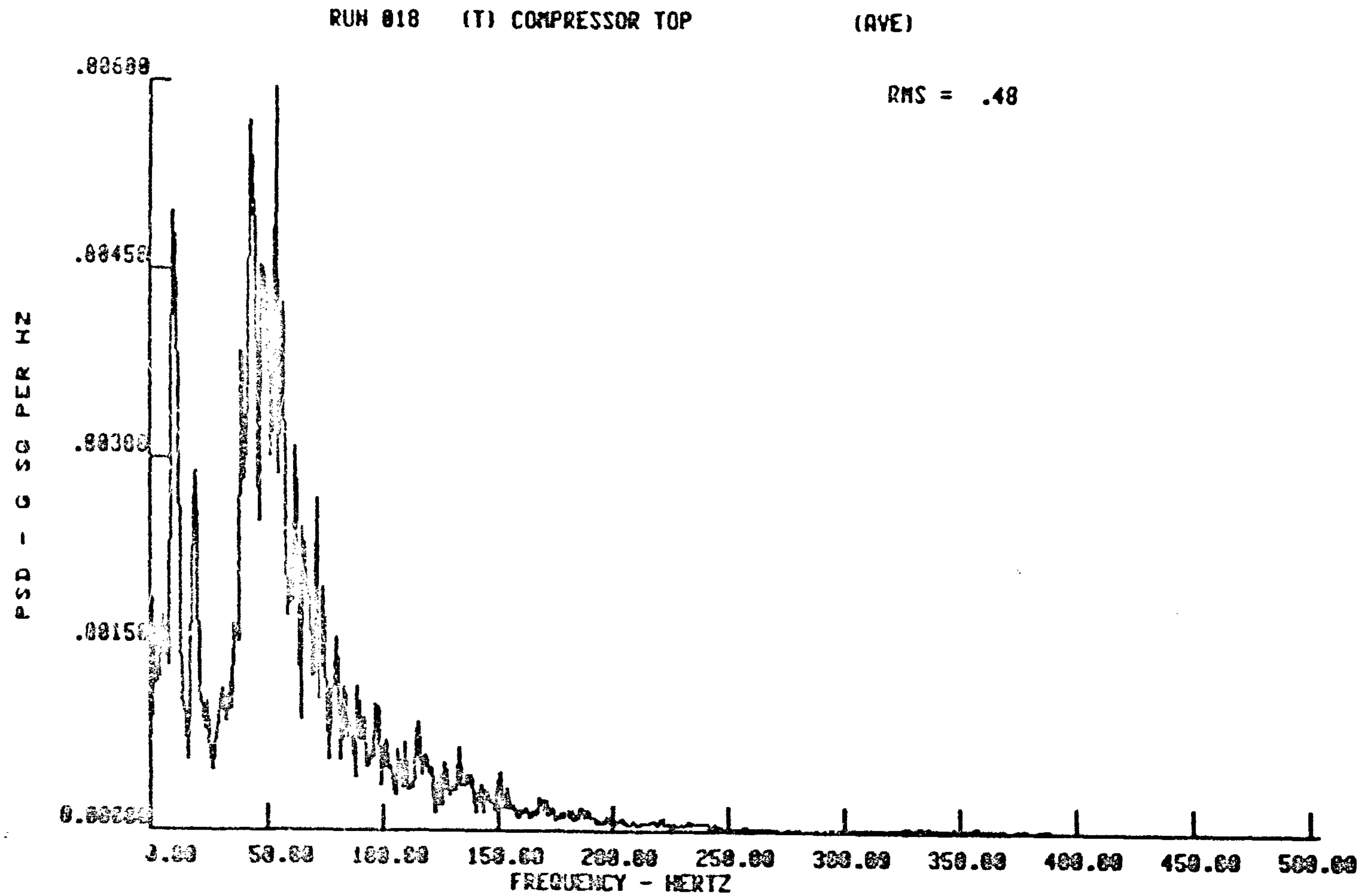



RUN 018 (T) COMPRESSOR BOTTOM (AVE)
RMS = .38
.00400
.00300
.00200
.00100
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

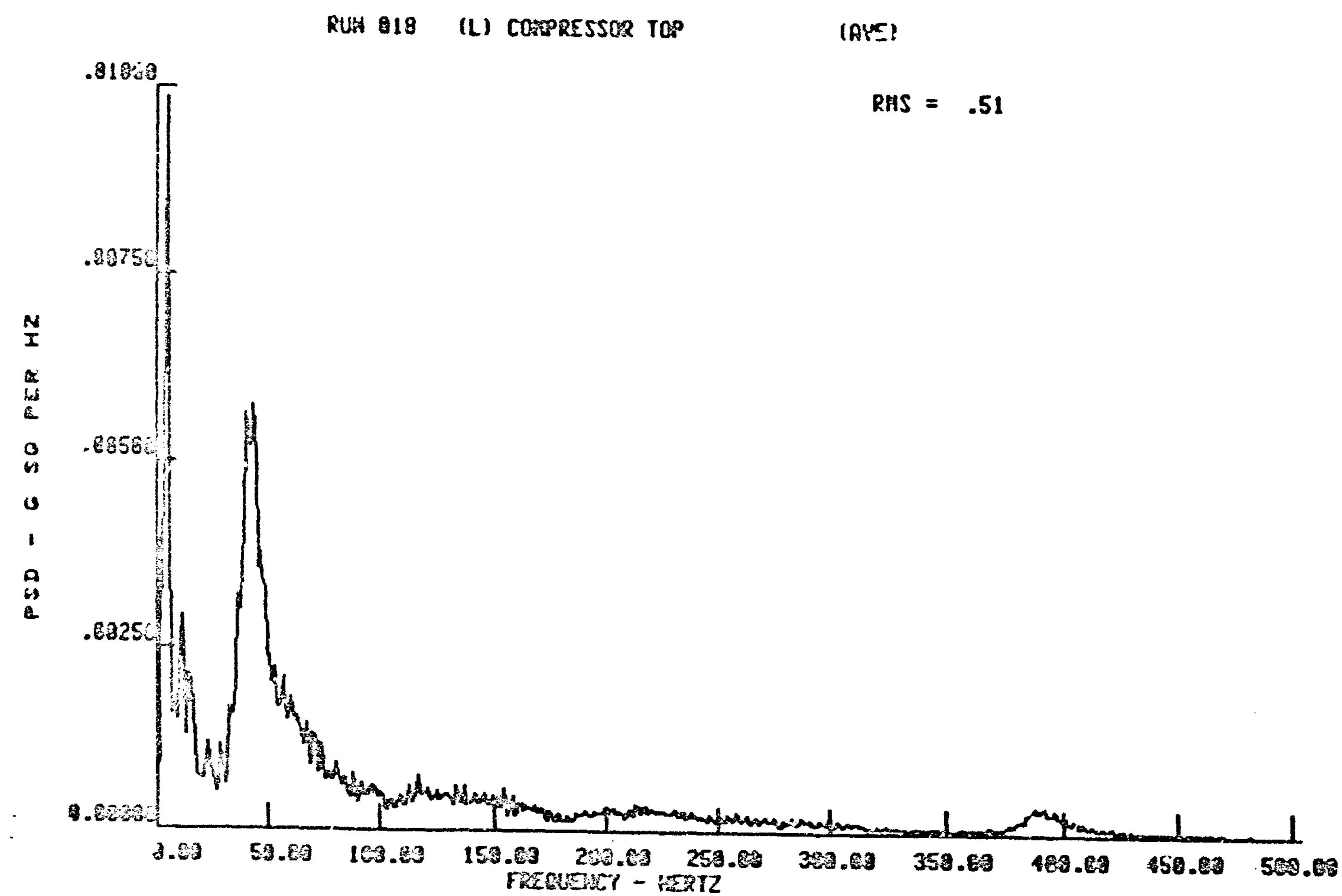

RUN 018 (L) COMPRESSOR BOTTOM (AVE)
RMS = .43
PSD - G SQ PER HZ
.00600
.00450
.00300
.00150
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ



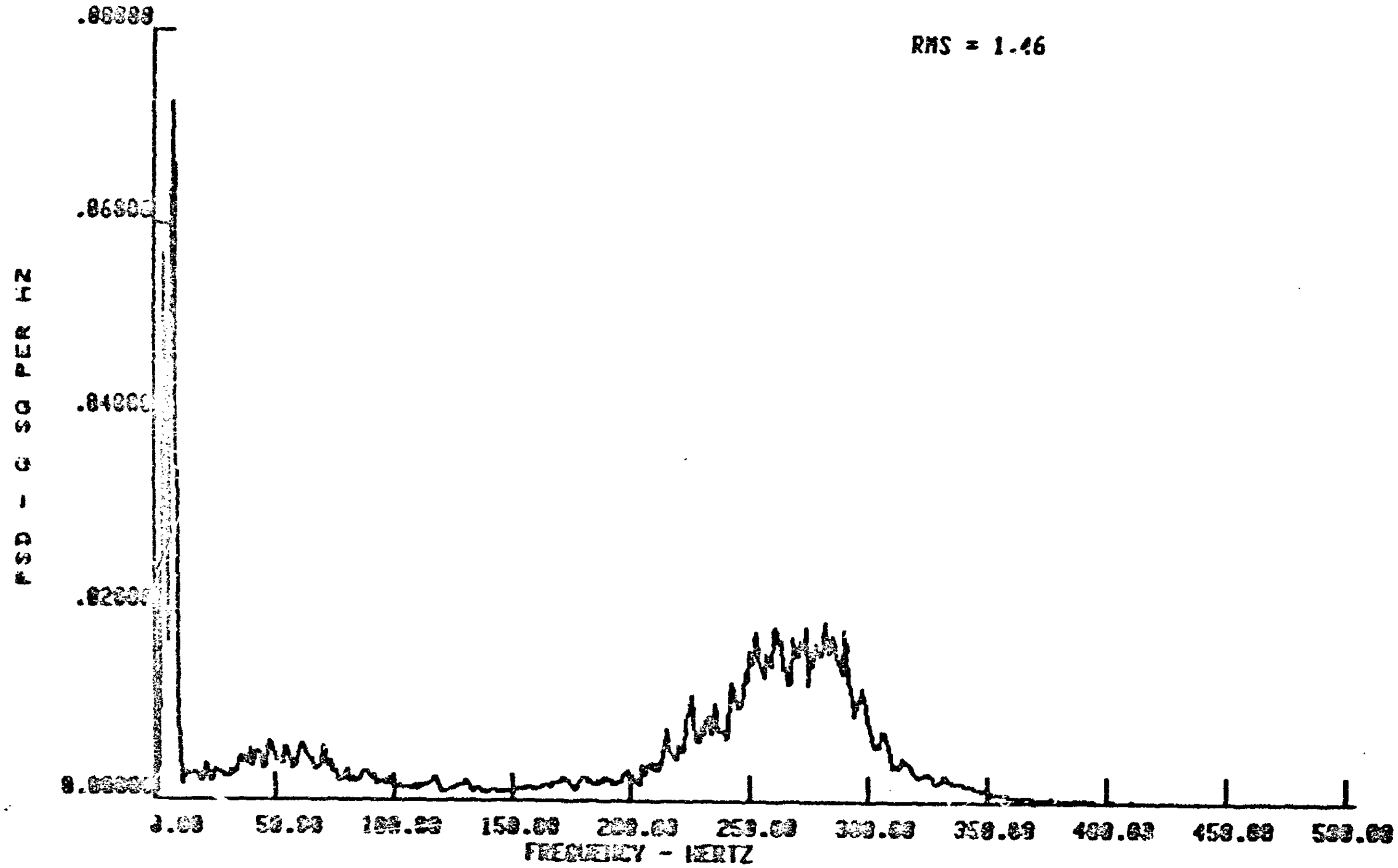
RUN 018 (V) COMPRESSOR TOP (AVE)
RMS = .34
.02000
.01500
.01000
.00500
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

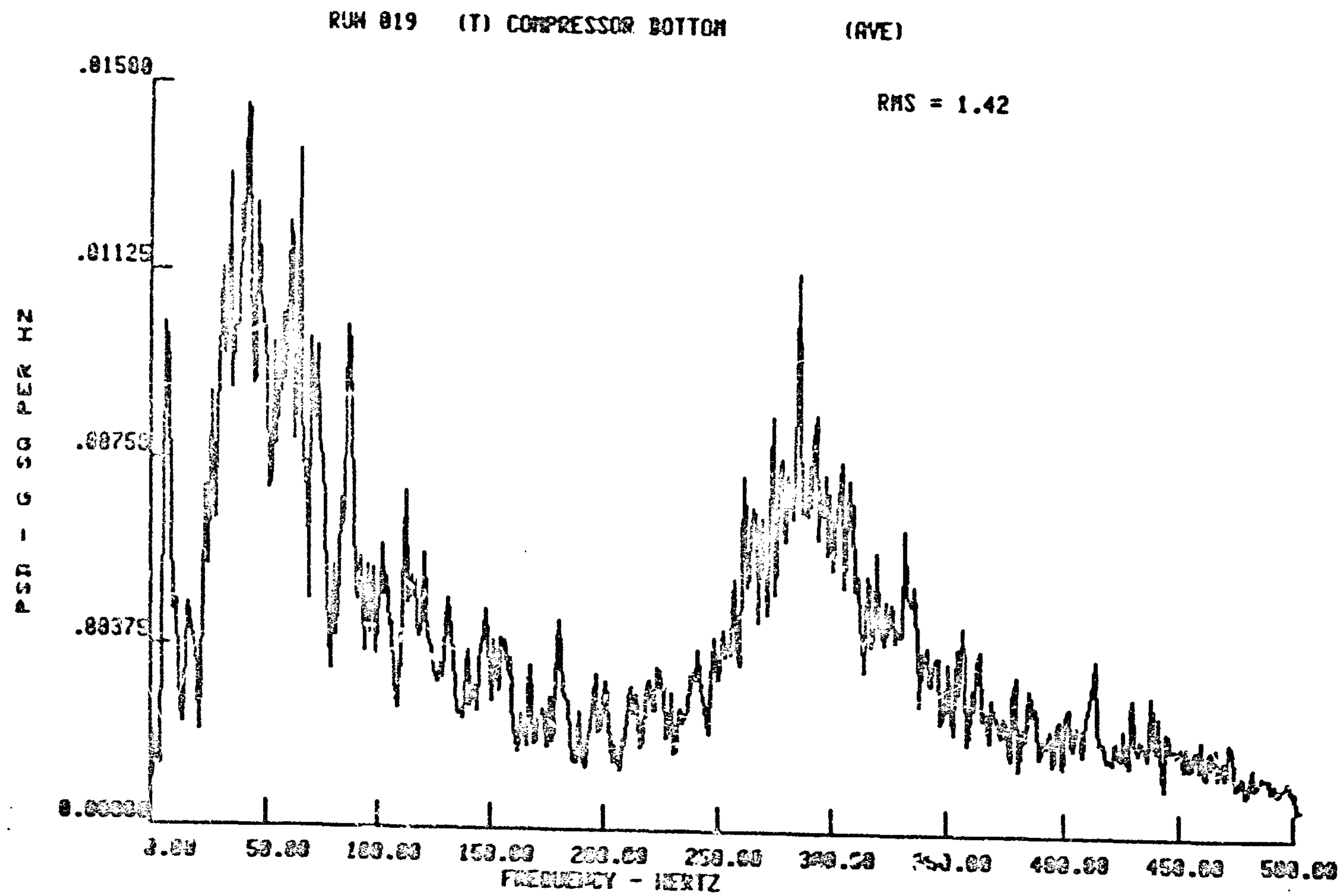


RUN 018 (T) COMPRESSOR TOP (AVE)
RMS = .48
.00600
.00450
.00300
.00150
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

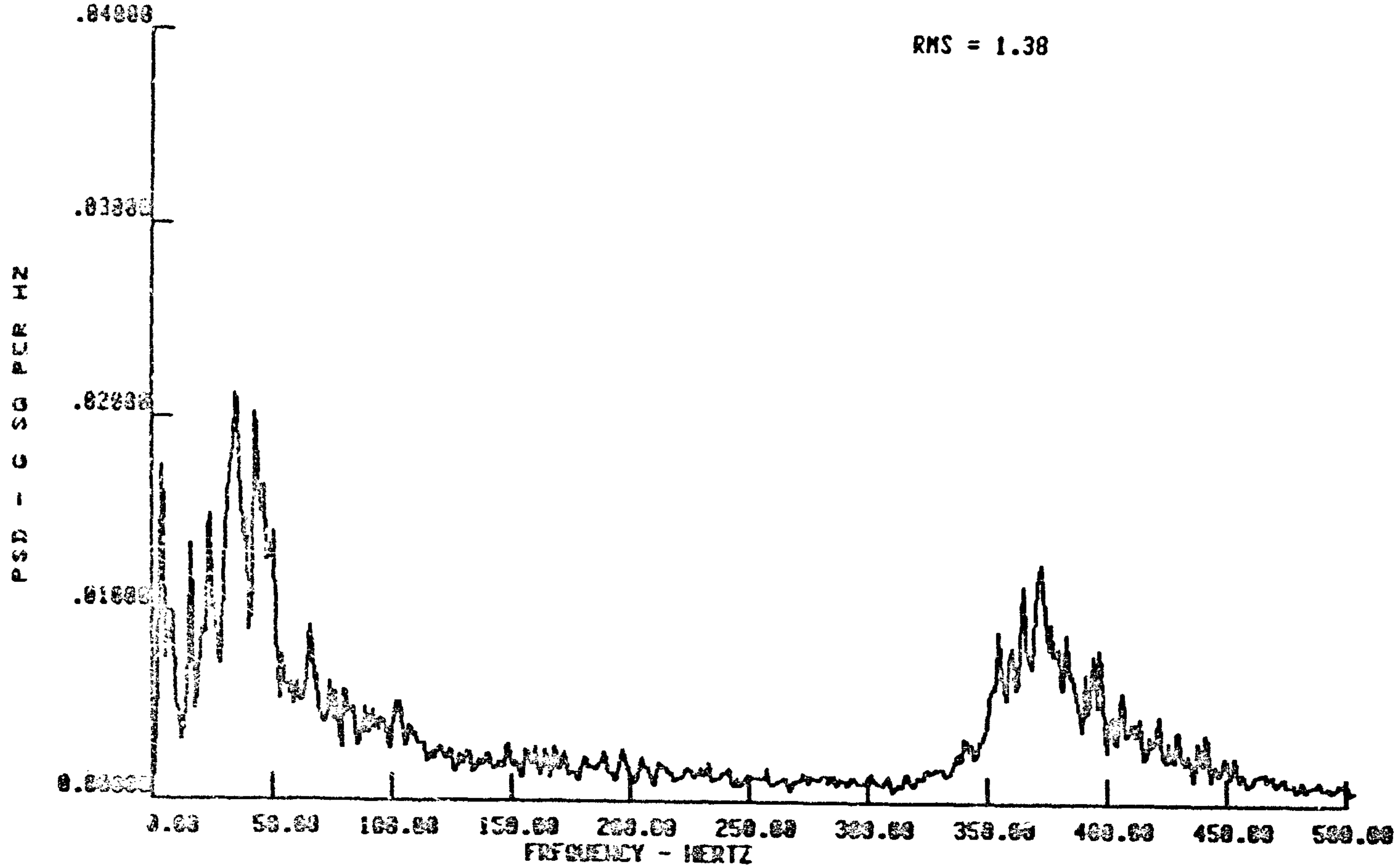

RUN 018 (L) COMPRESSOR TOP (AVE)
RMS = .51
.01000
.00750
.00500
.00250
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

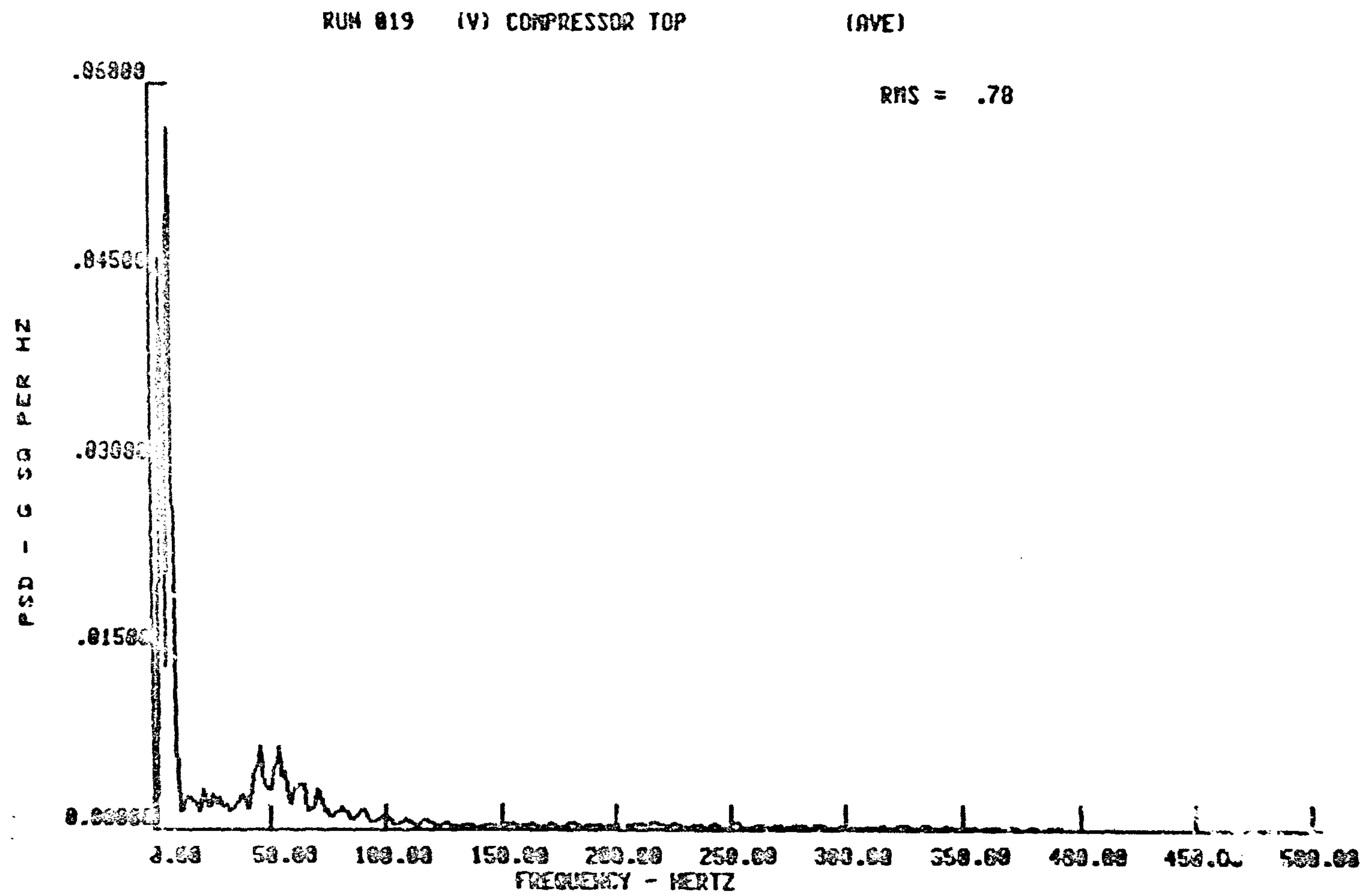
RUN 019 (V) COMPRESSOR BOTTOM (AVE)

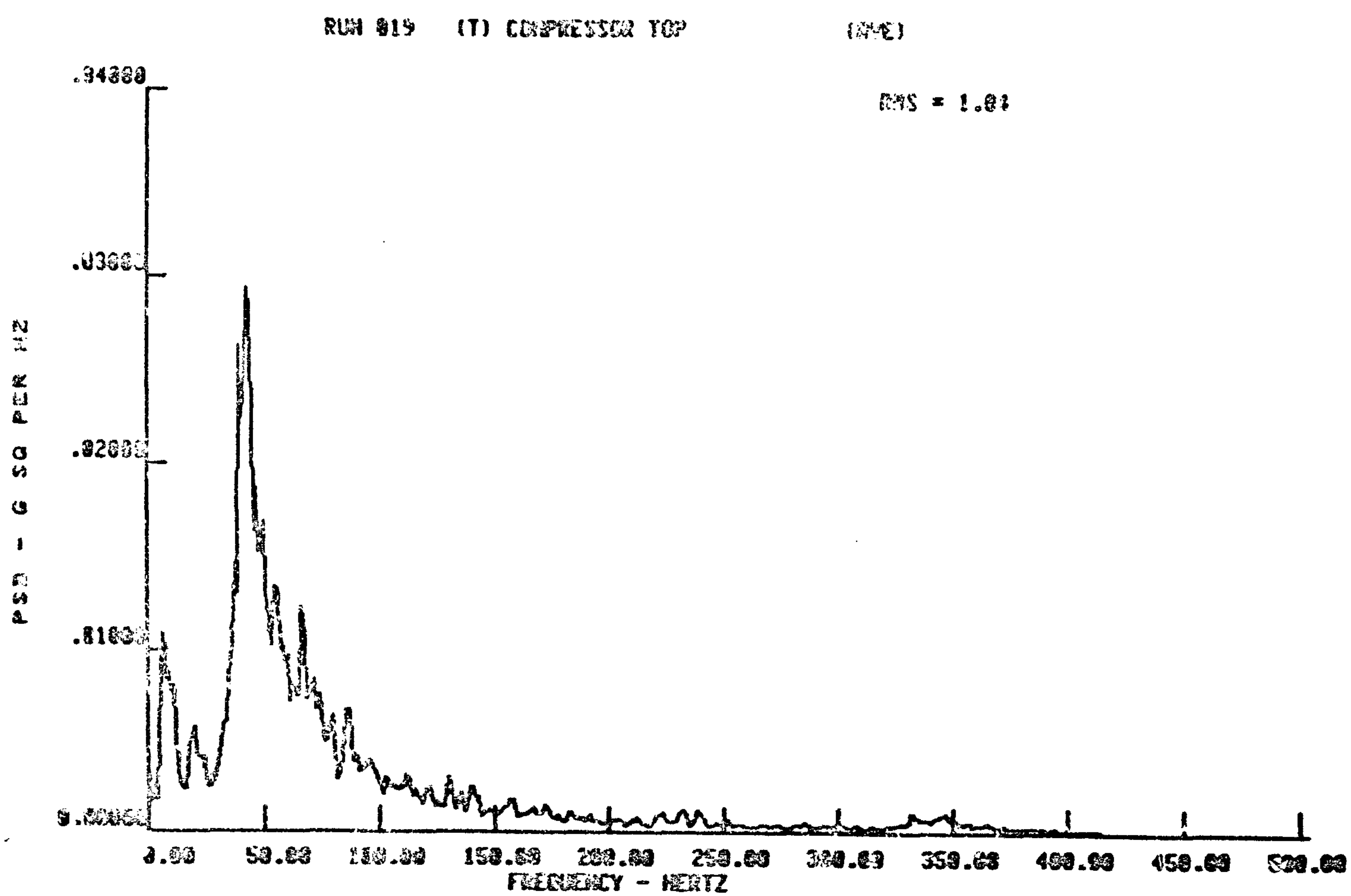


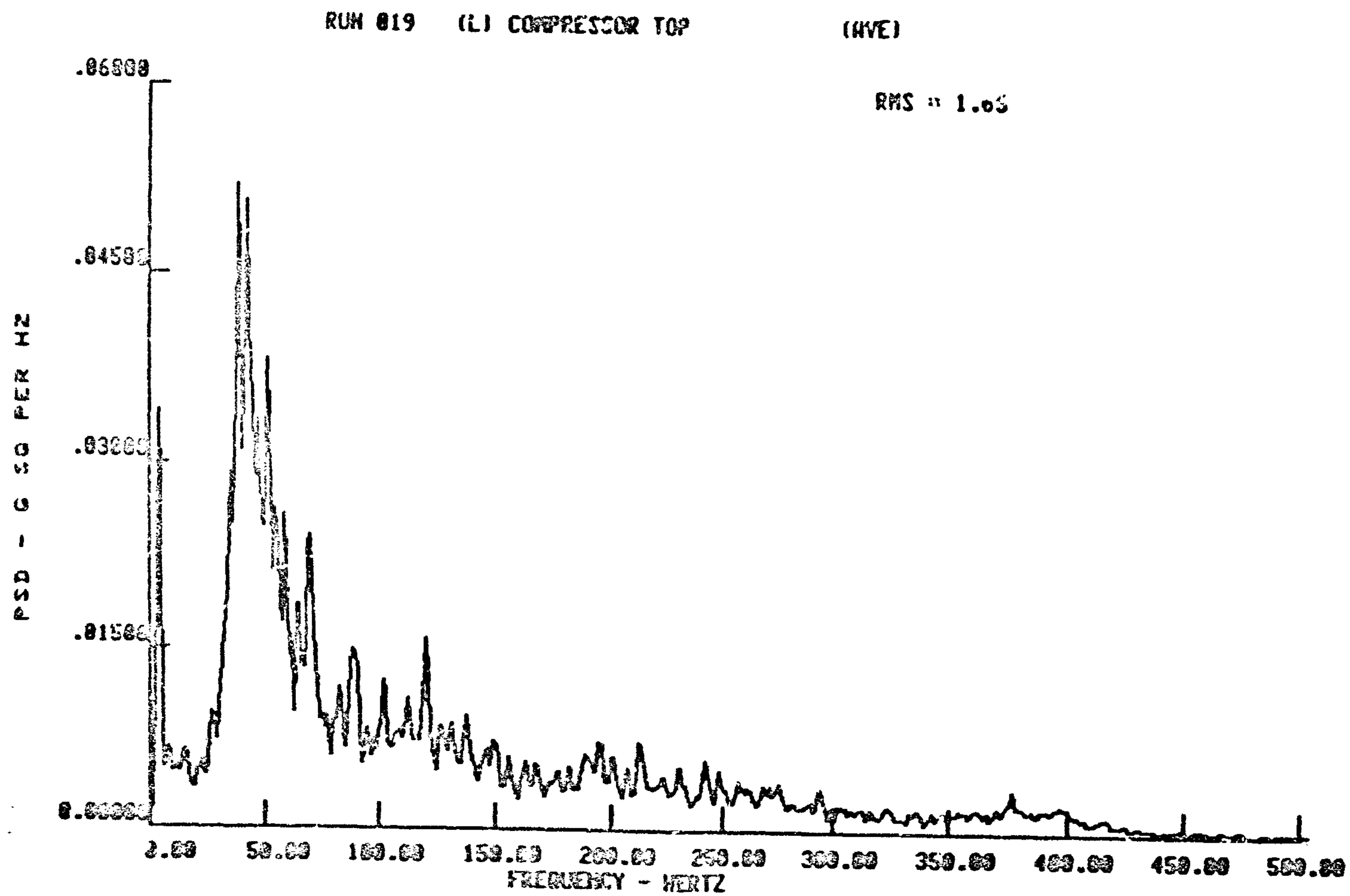

RUN 019 (T) COMPRESSOR BOTTOM (AVE)
RMS = 1.42
.01500
.01125
.00750
.00375
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

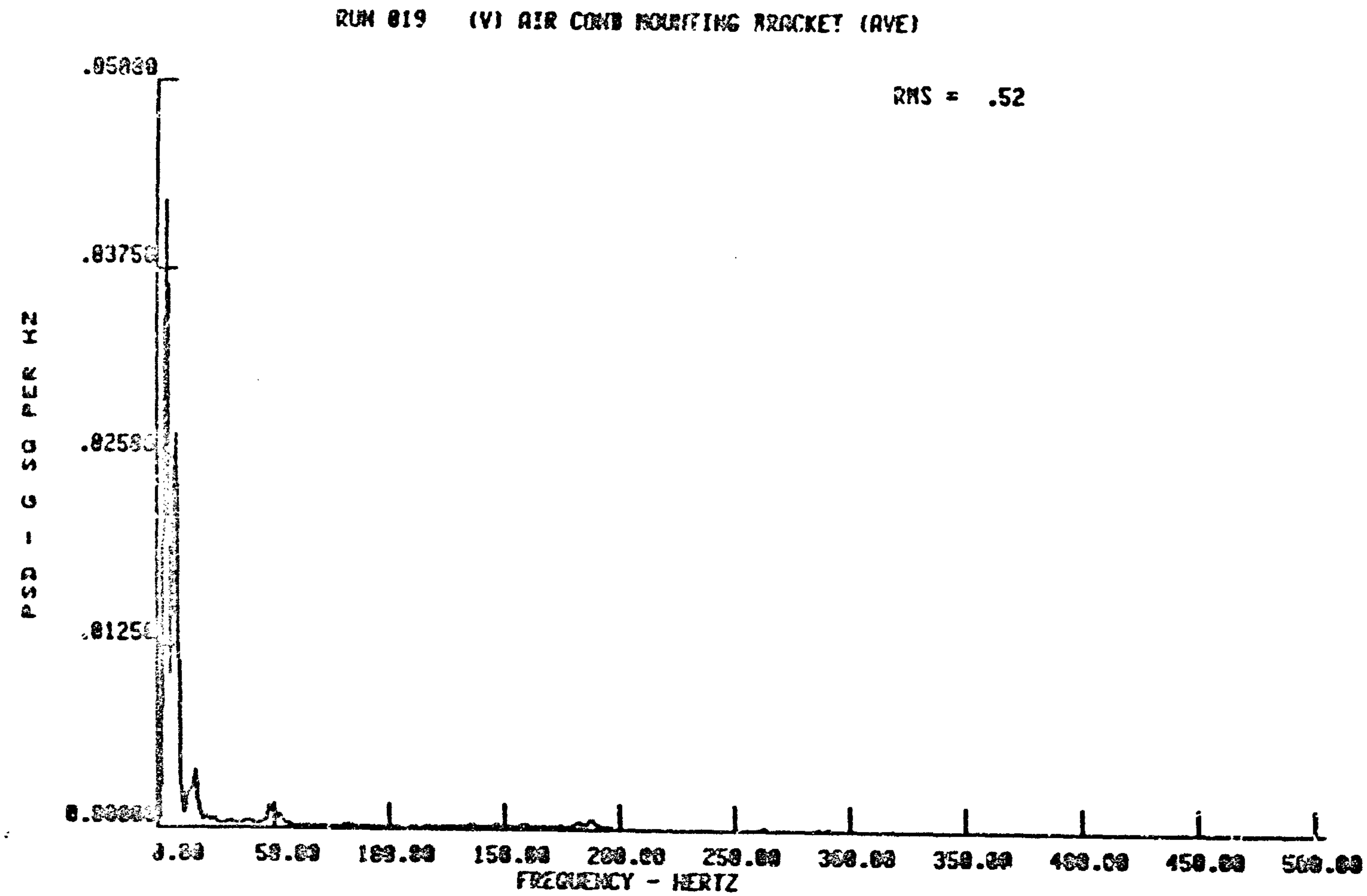
RUN 019 (L) COMPRESSOR BOTTOM (AVE)

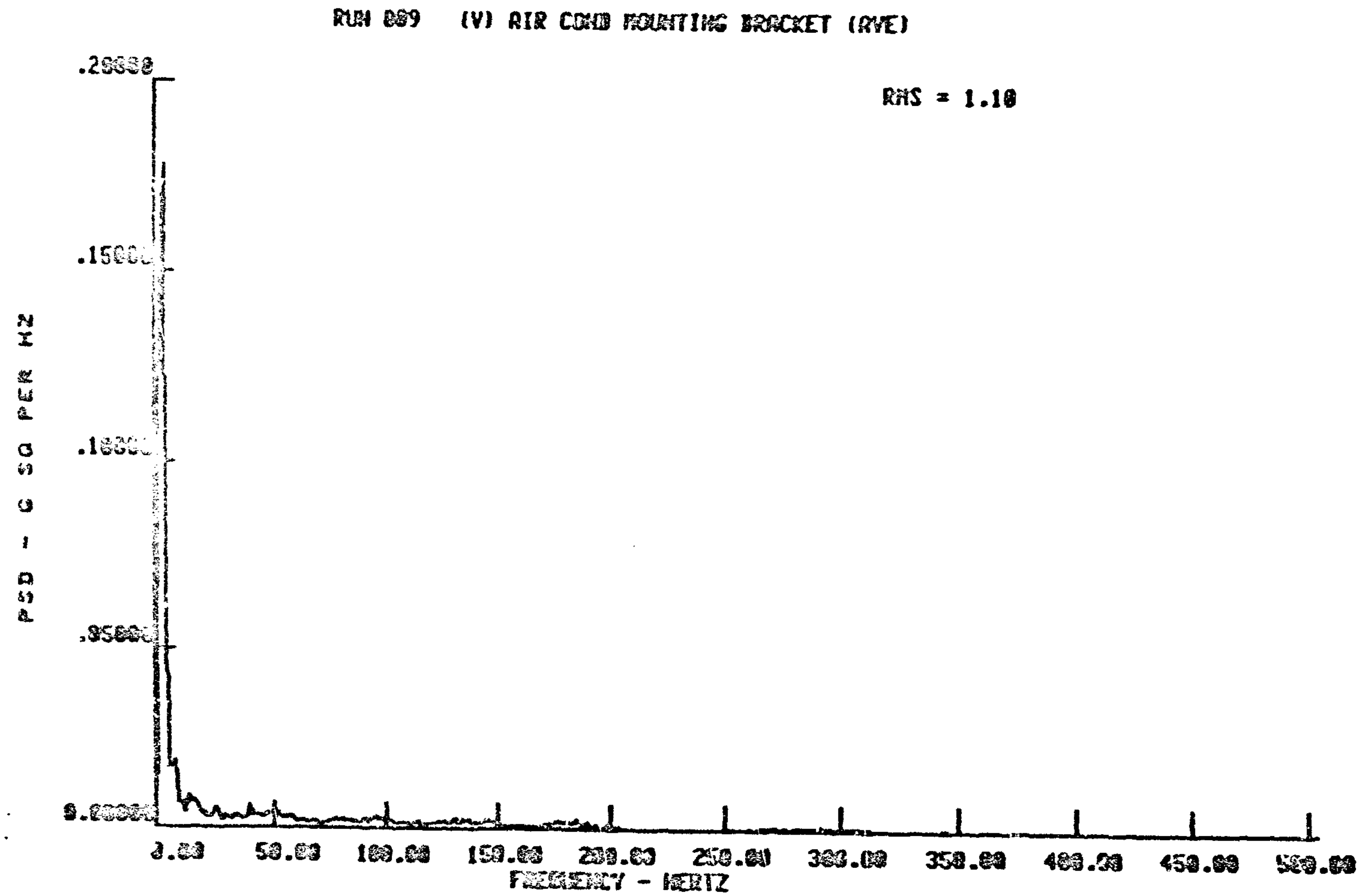


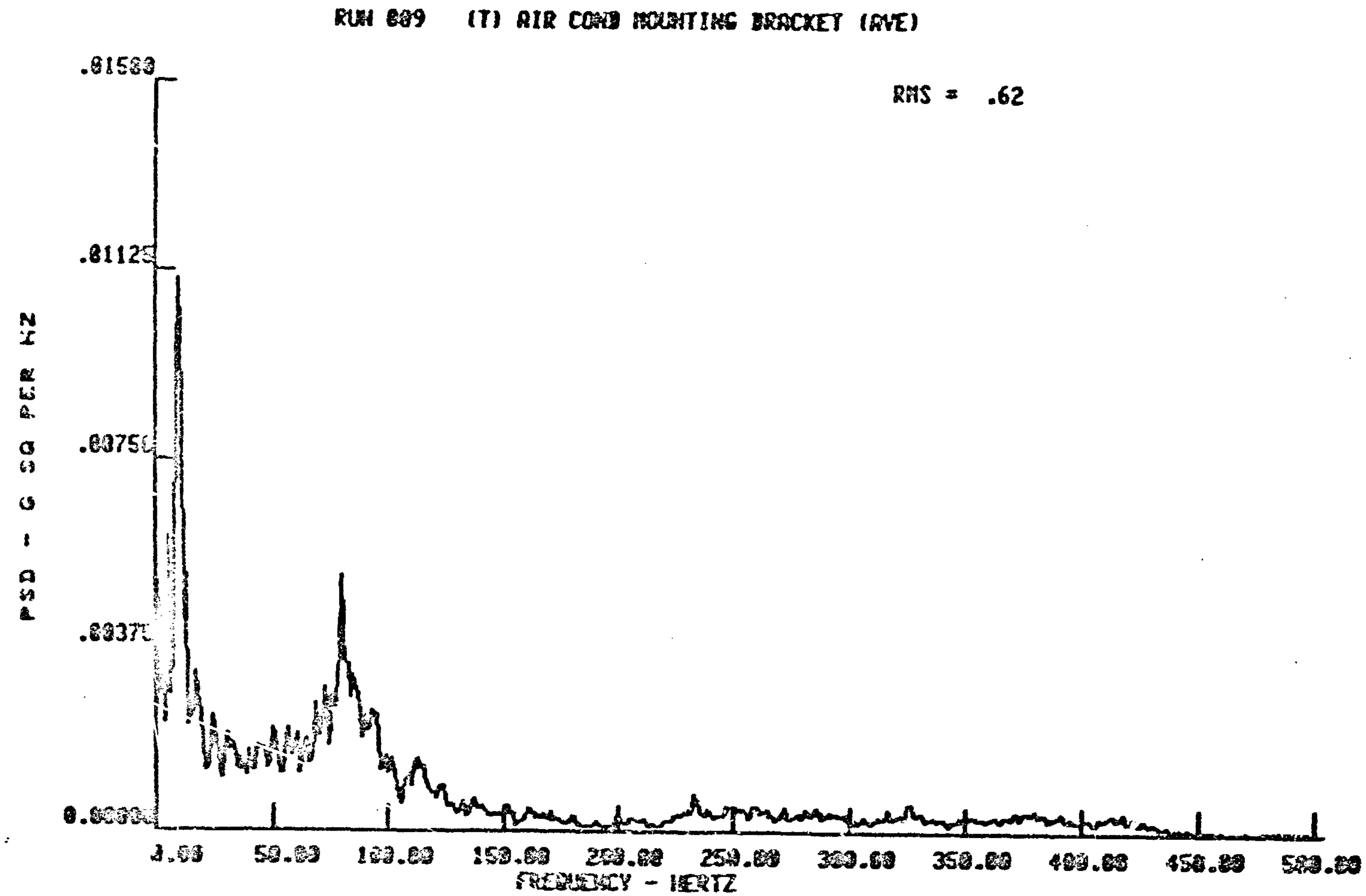

RUN 019 (V) COMPRESSOR TOP (AVE)
RMS = .78
.06000
.04500
.03000
.01500
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
500.00
FREQUENCY - HERTZ

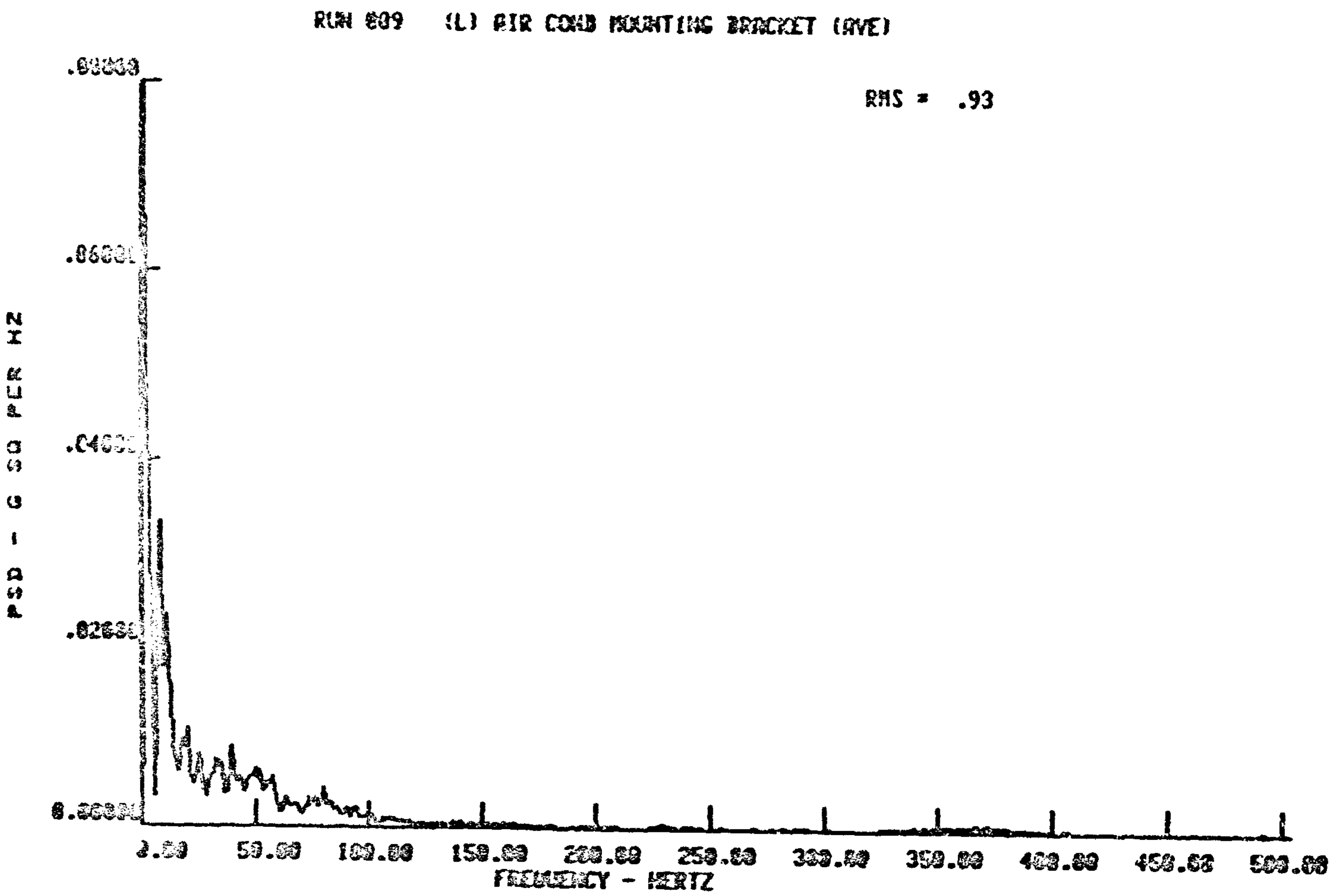

RUN 019 (T) COMPRESSOR TOP (RME)
RMS = 1.01
.04000
.03000
.02000
.01000
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

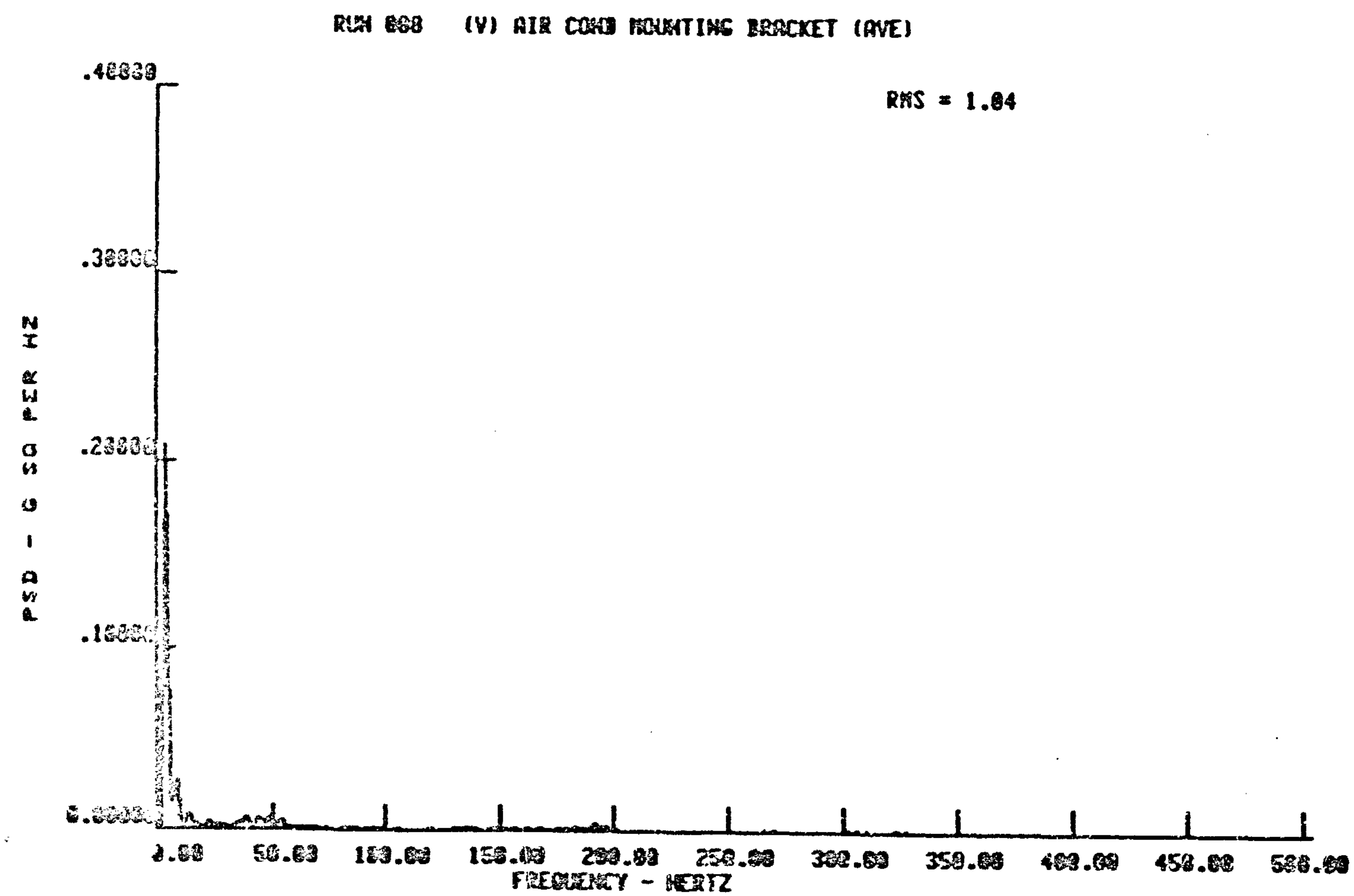

RUN 019 (L) COMPRESSOR TOP (AVE)
RMS = 1.05
PSD - G SQ PER HZ
.06000
.04500
.03000
.01500
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

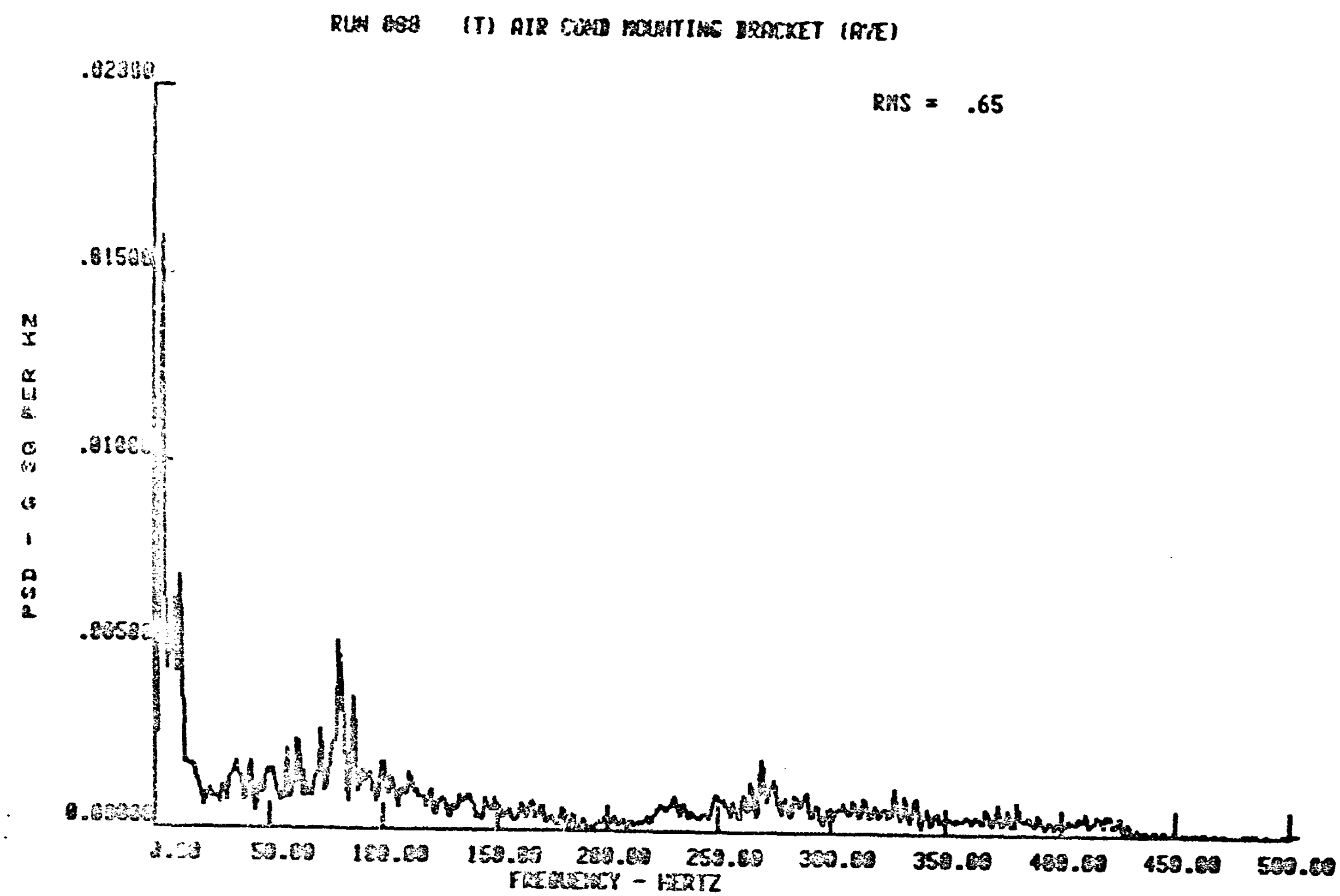

RUN 019 (V) AIR COND MOUNTING BRACKET (AVE)
RMS = .52
.05000
.03750
.02500
.01250
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ


RUN 089 (V) AIR COND MOUNTING BRACKET (AVE)
RMS = 1.10
.20000
.15000
.10000
.05000
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

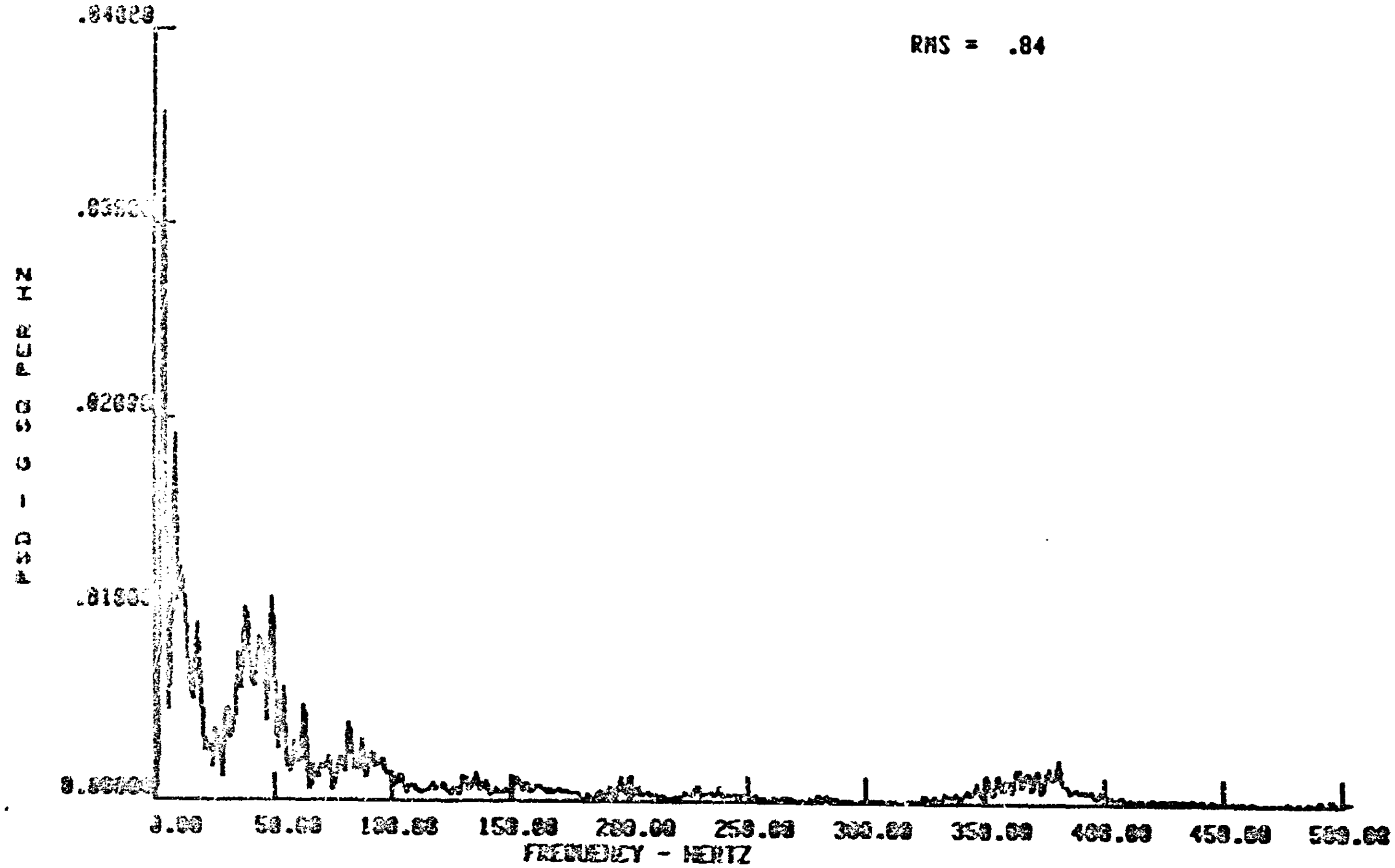

RUN 009 (T) AIR COND MOUNTING BRACKET (AVE)
RMS = .62
PSD - G SQ PER HZ
.01500
.01125
.00750
.00375
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ


RUN 809 (L) AIR COND MOUNTING BRACKET (AVE)
RMS = .93
PSD - G SQ PER HZ
FREQUENCY - HERTZ

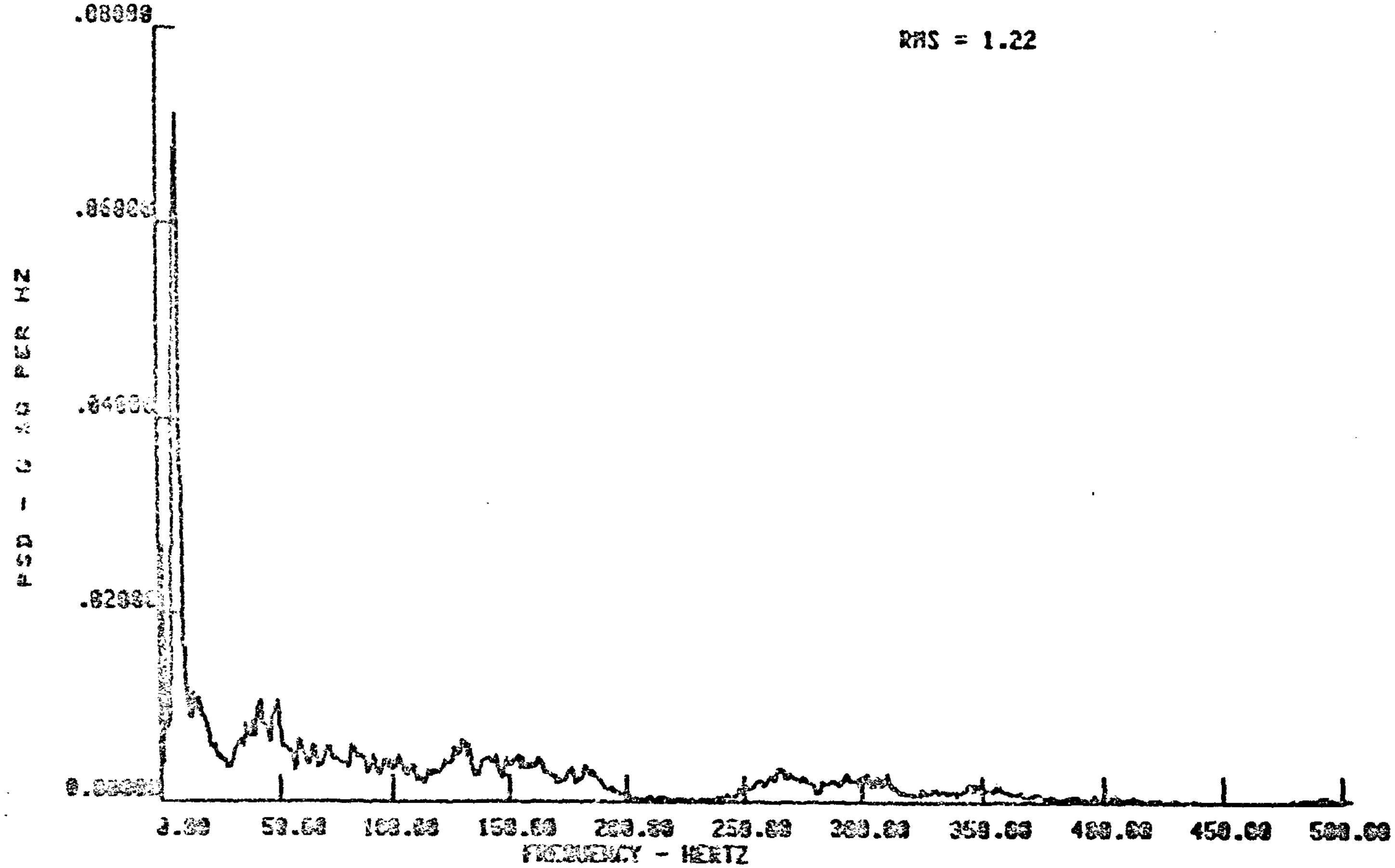

RUN 008 (V) AIR COND MOUNTING BRACKET (AVE)
RMS = 1.04
.40000
.30000
.20000
.10000
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

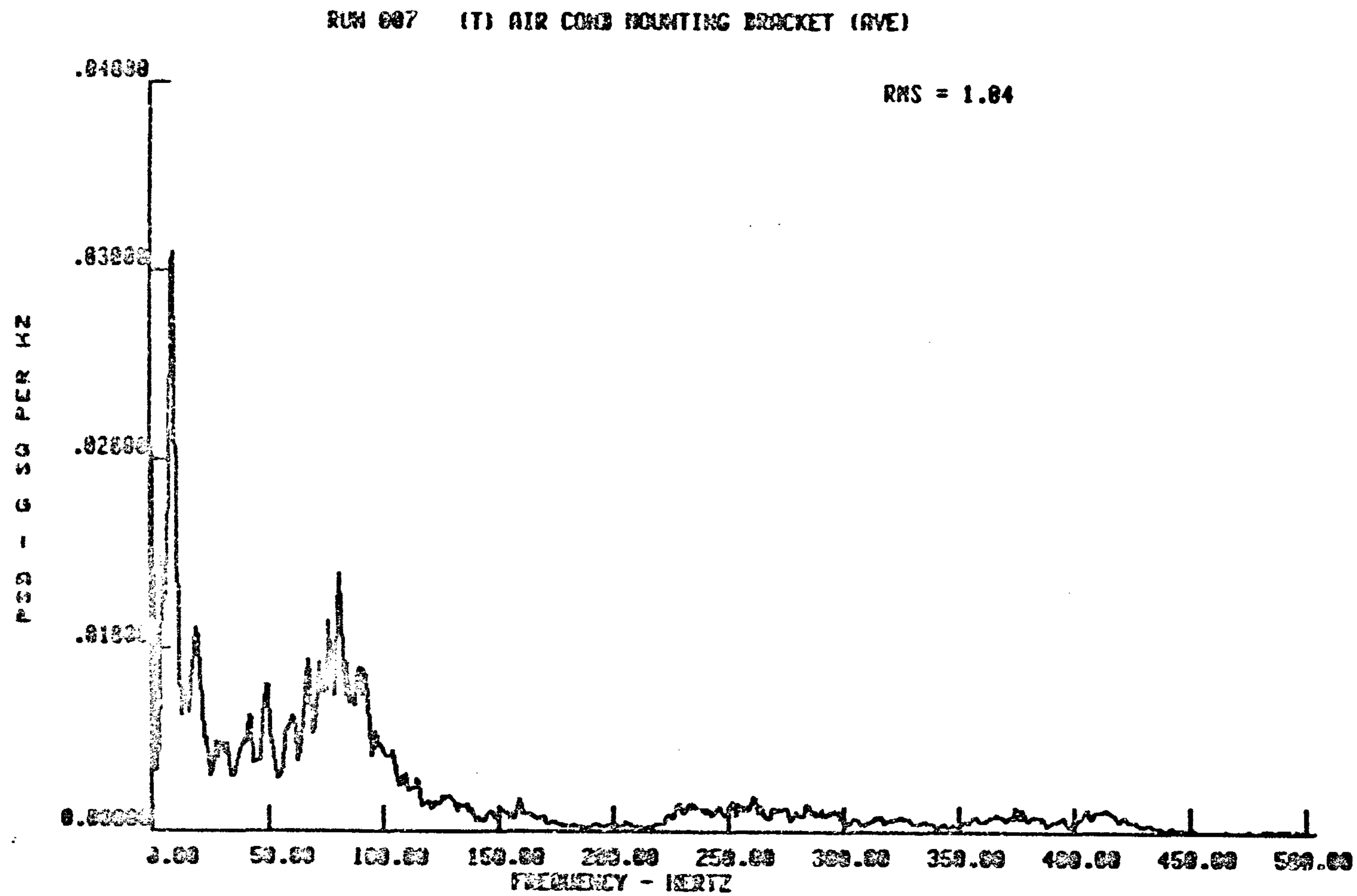

RUN 088 (T) AIR COND MOUNTING BRACKET (A/E)
RMS = .65
PSD - G SQ PER HZ
.02300
.01500
.01000
.00500
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

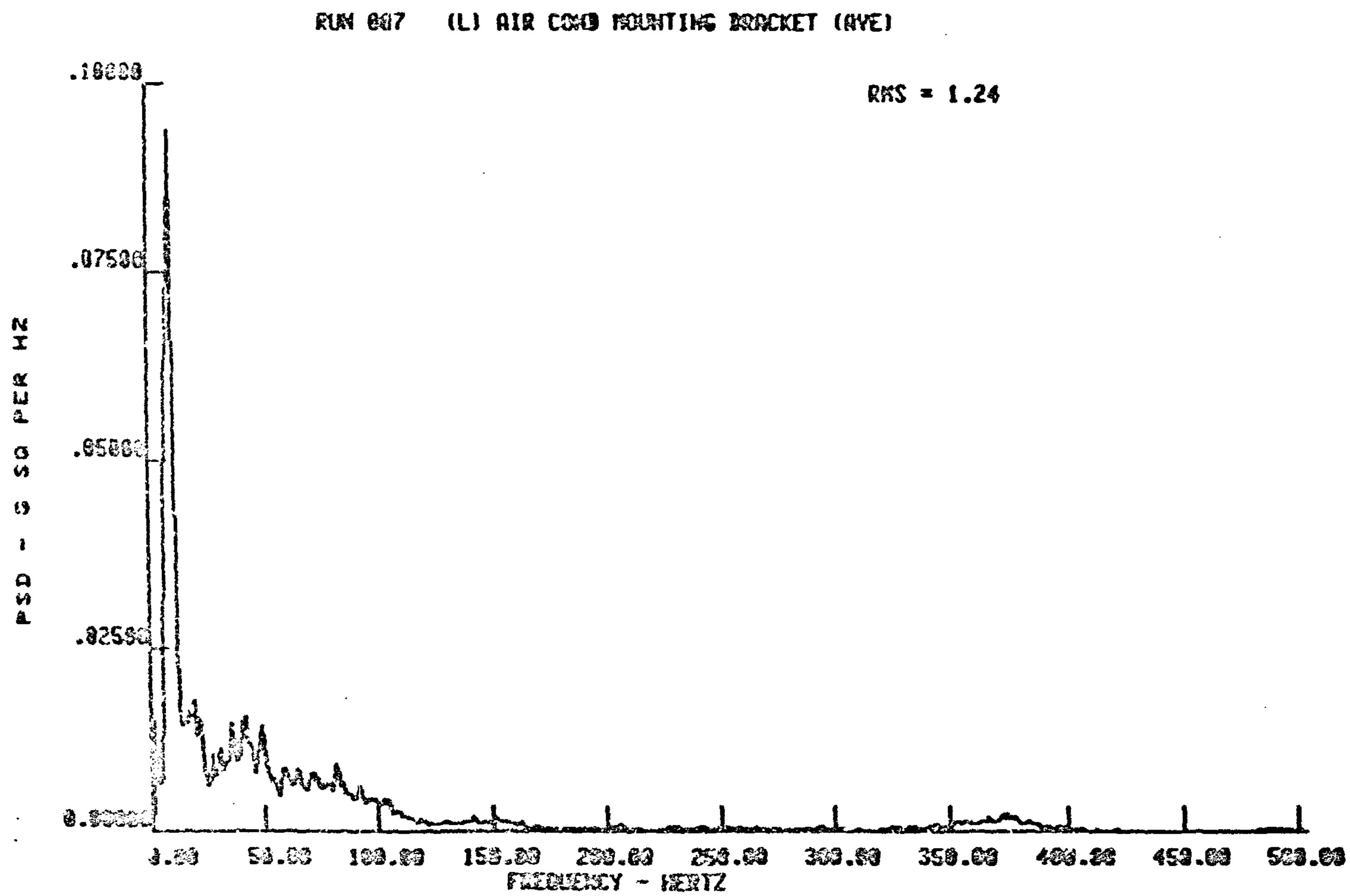
RUN 680 (L) AIR COND MOUNTING BRACKET (AVE)

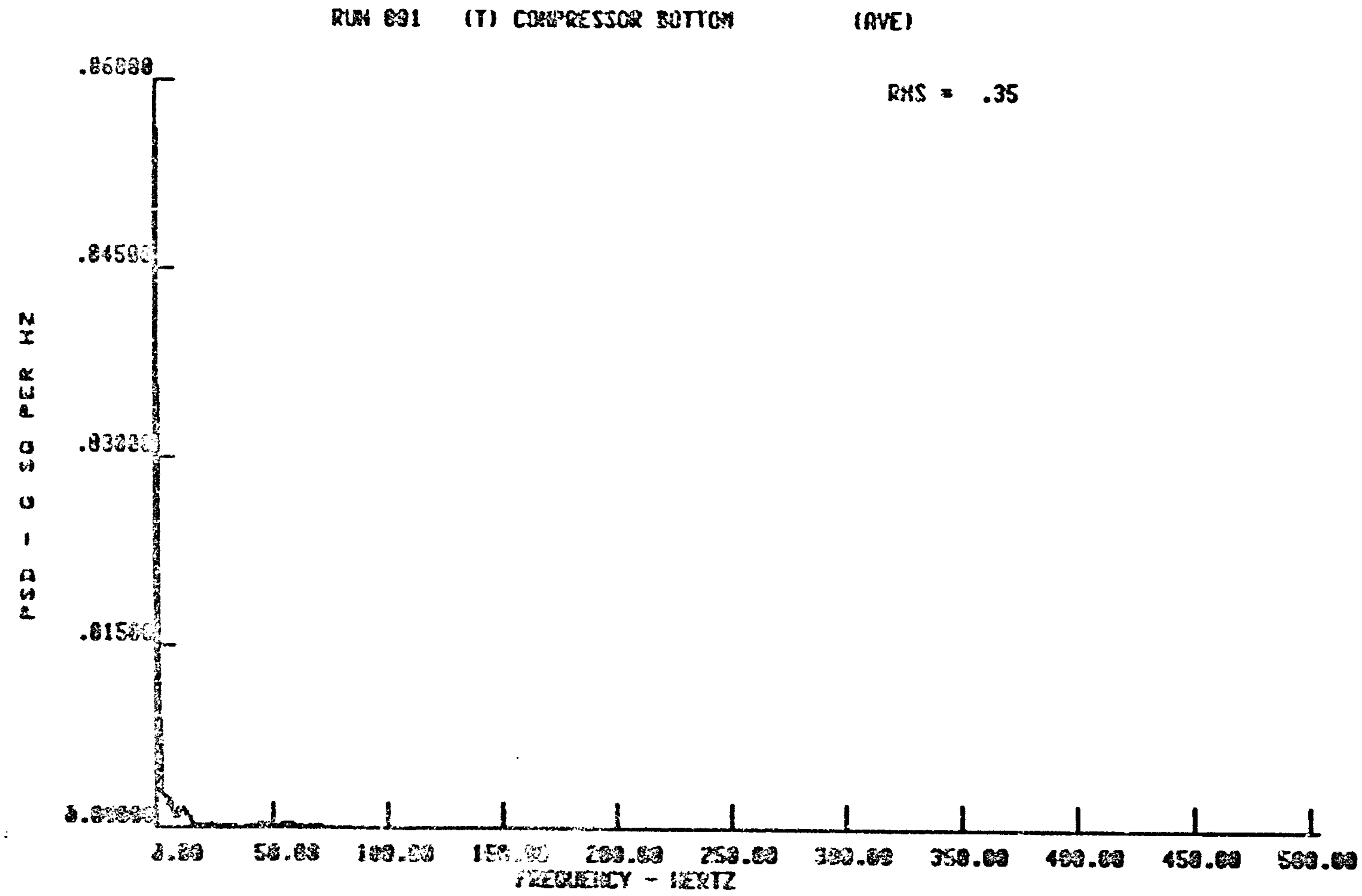


RUN 867 (V) AIR COND MOUNTING BRACKET (AVE)



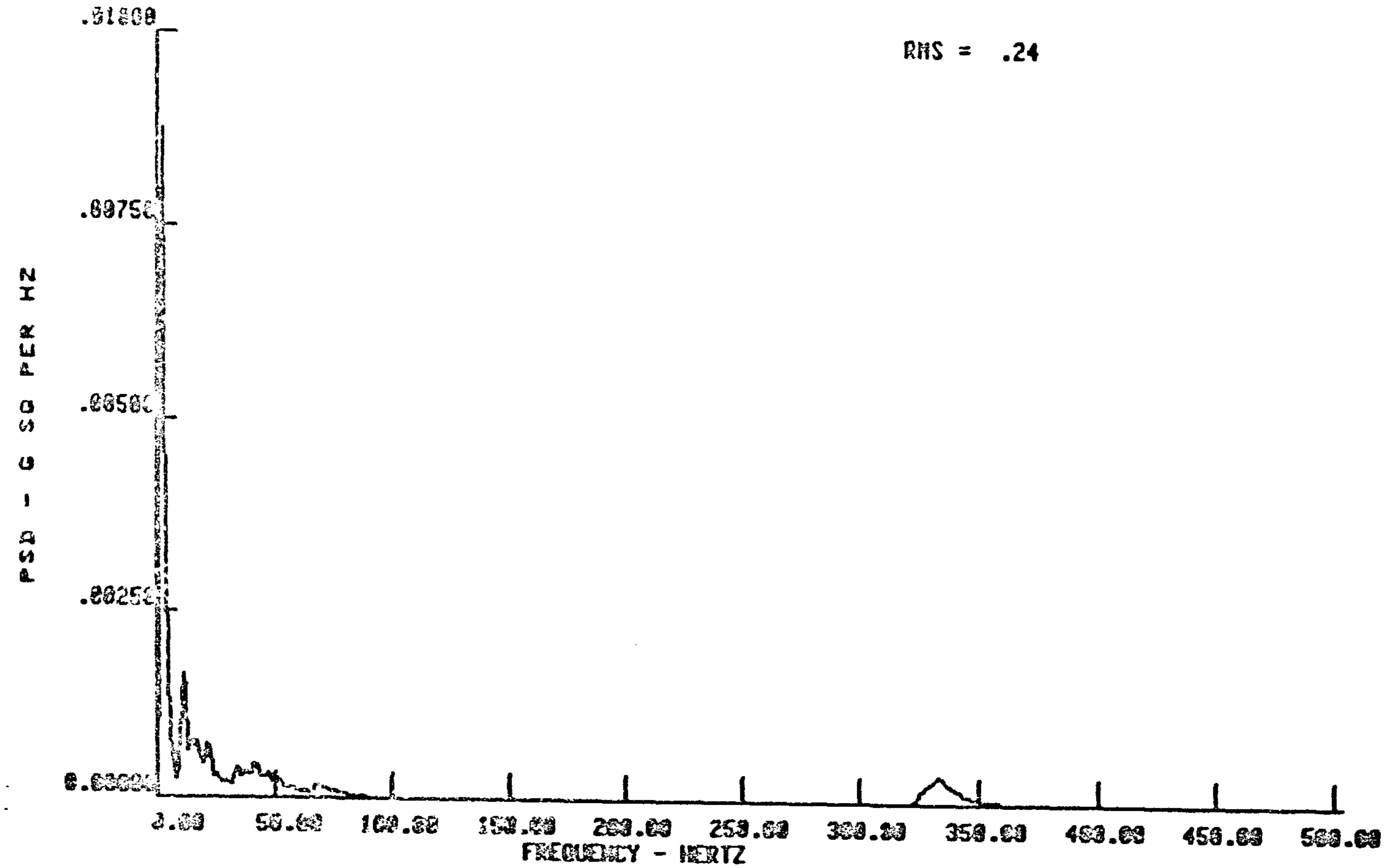

RUN 007 (T) AIR COND MOUNTING BRACKET (AVE)
RMS = 1.04
.04000
.03000
.02000
.01000
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

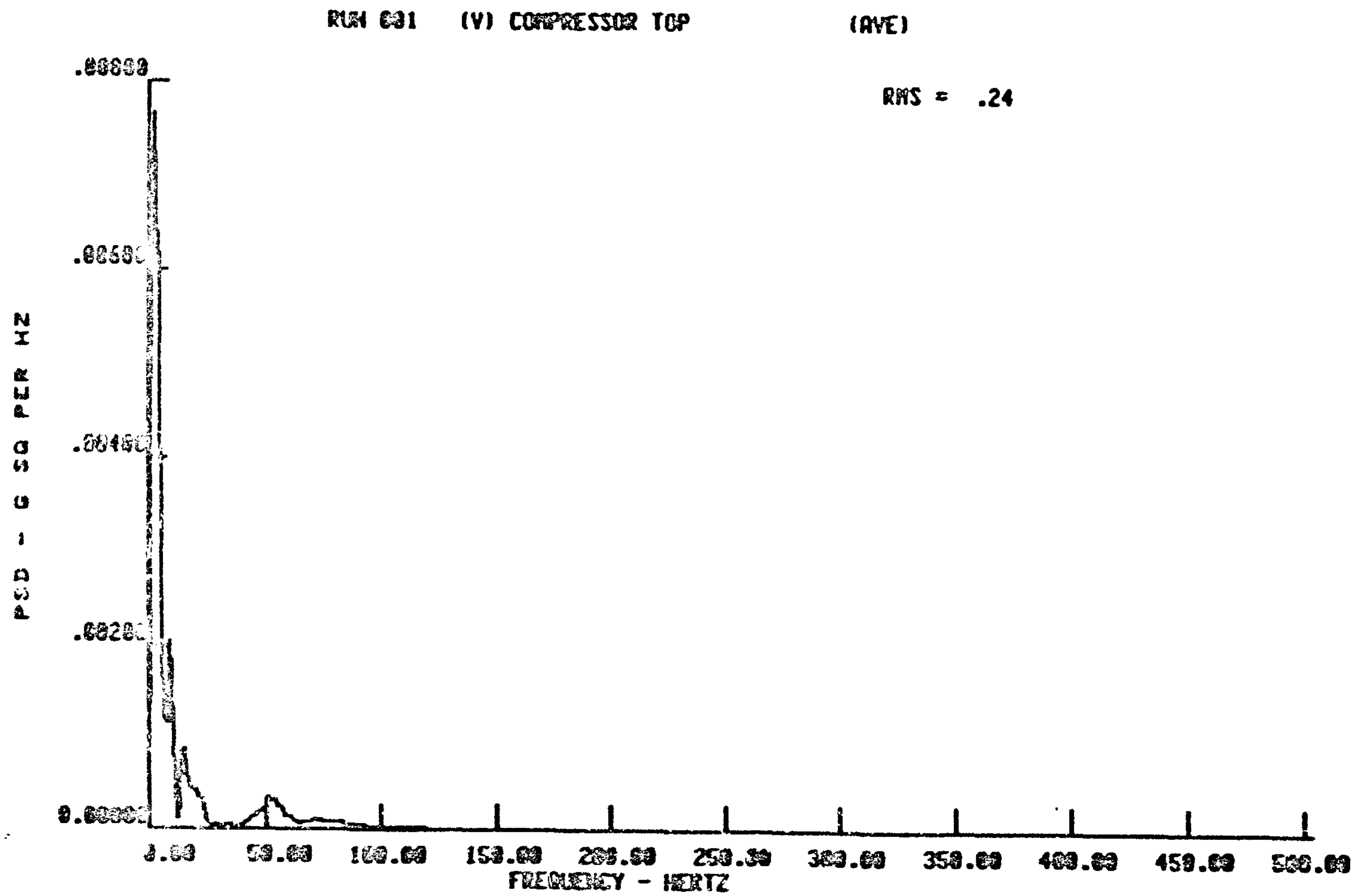

RUN 007 (L) AIR COND MOUNTING BRACKET (AVE)
RMS = 1.24
PSD - G SQ PER HZ
.10000
.07500
.05000
.02500
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

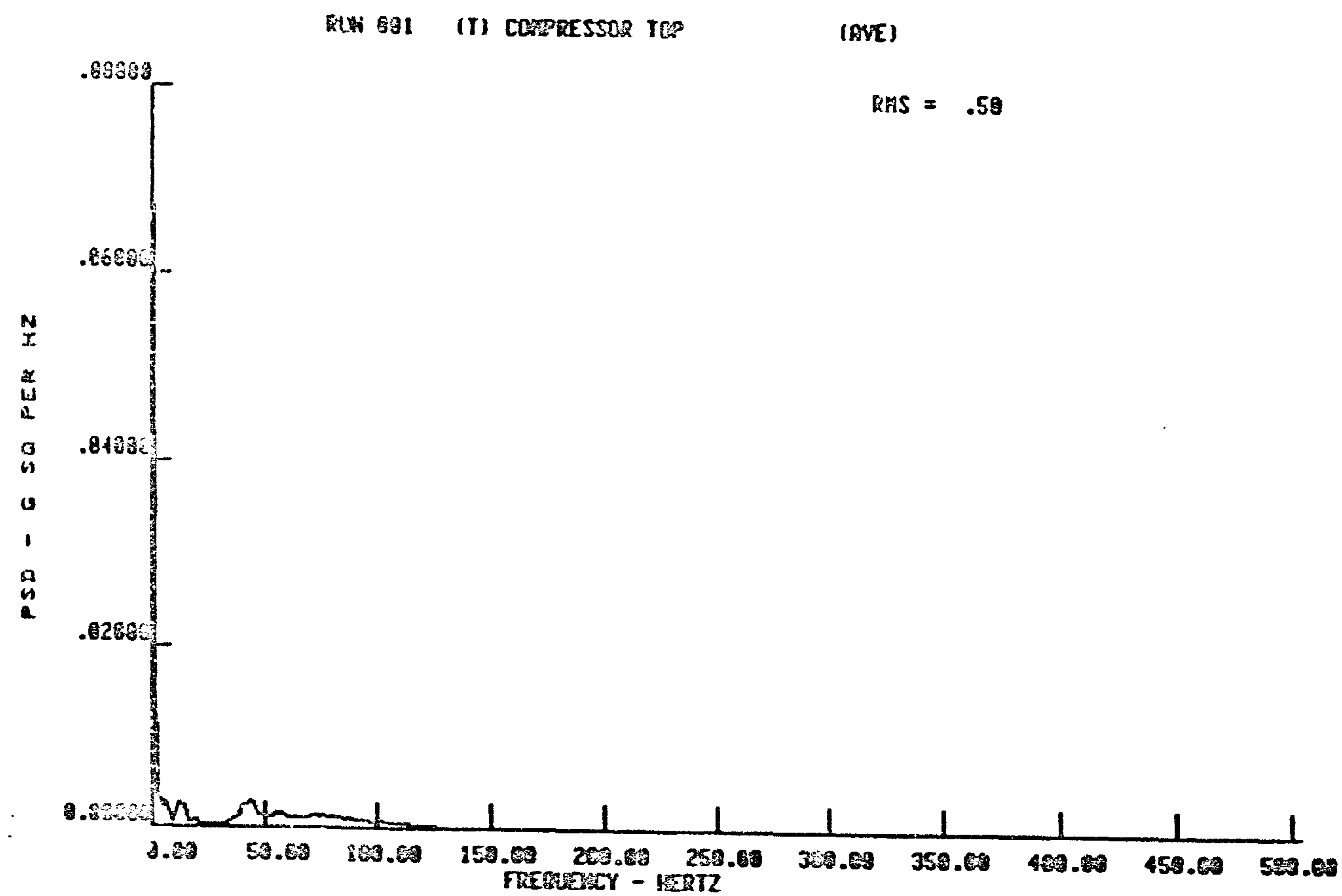


RUN 091 (T) COMPRESSOR BOTTOM (AVE)
RMS = .35
.06000
.04500
.03000
.01500
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

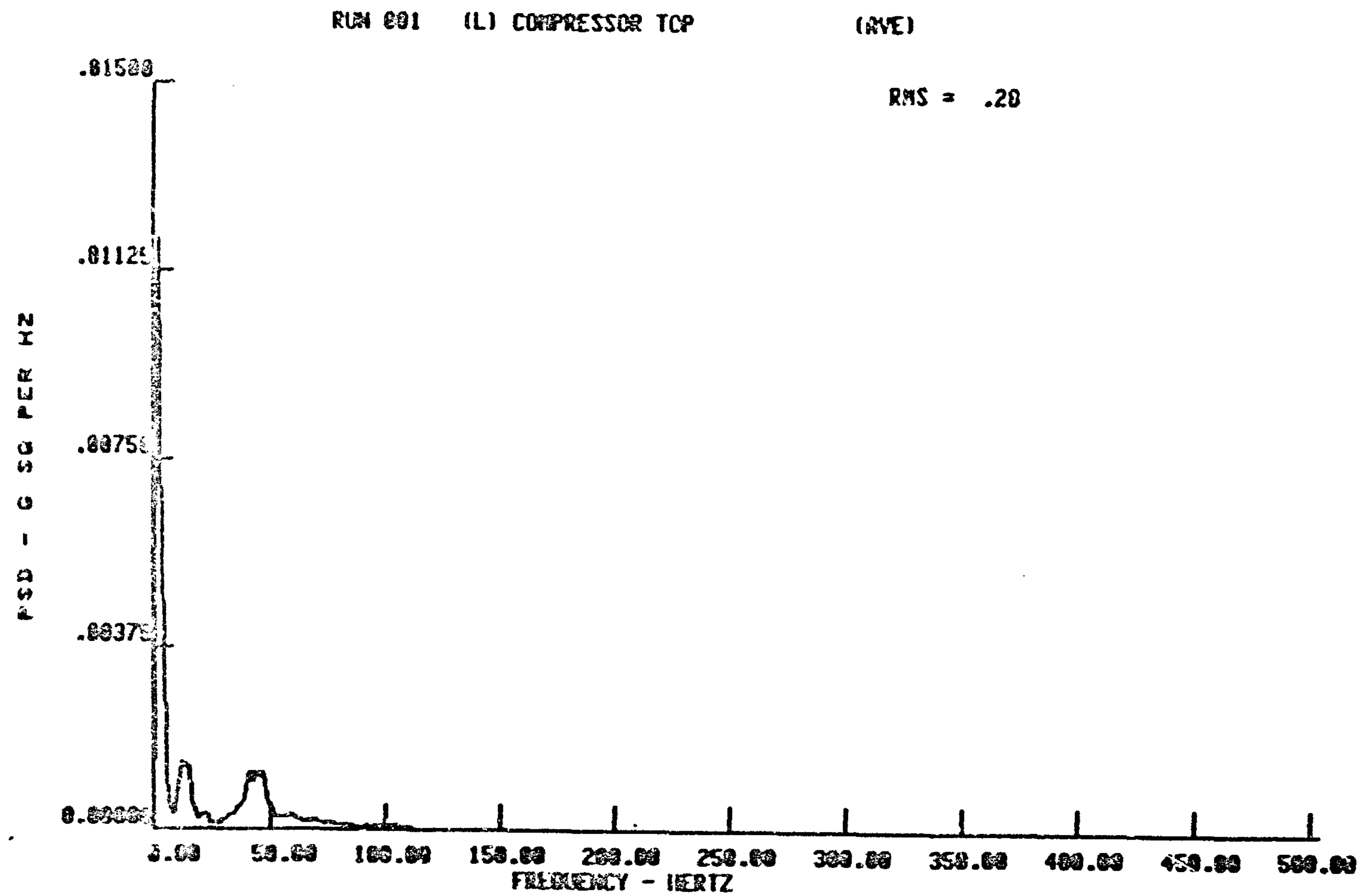
RUN 001 (L) COMPRESSOR BOTTOM (AVE)

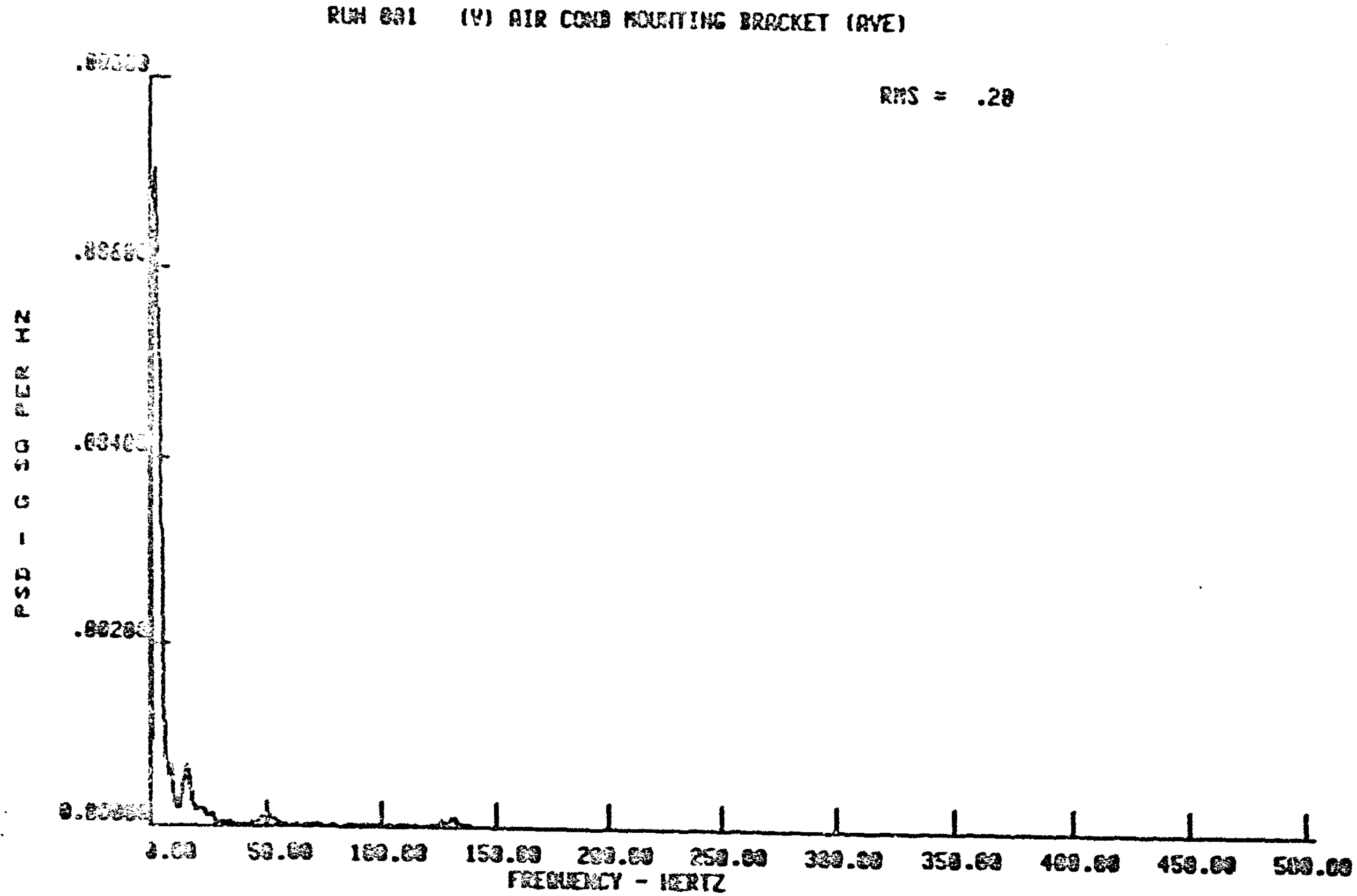



RUN 031 (V) COMPRESSOR TOP (AVE)
RMS = .24
PSD - G SQ PER HZ
.00800
.00600
.00400
.00200
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

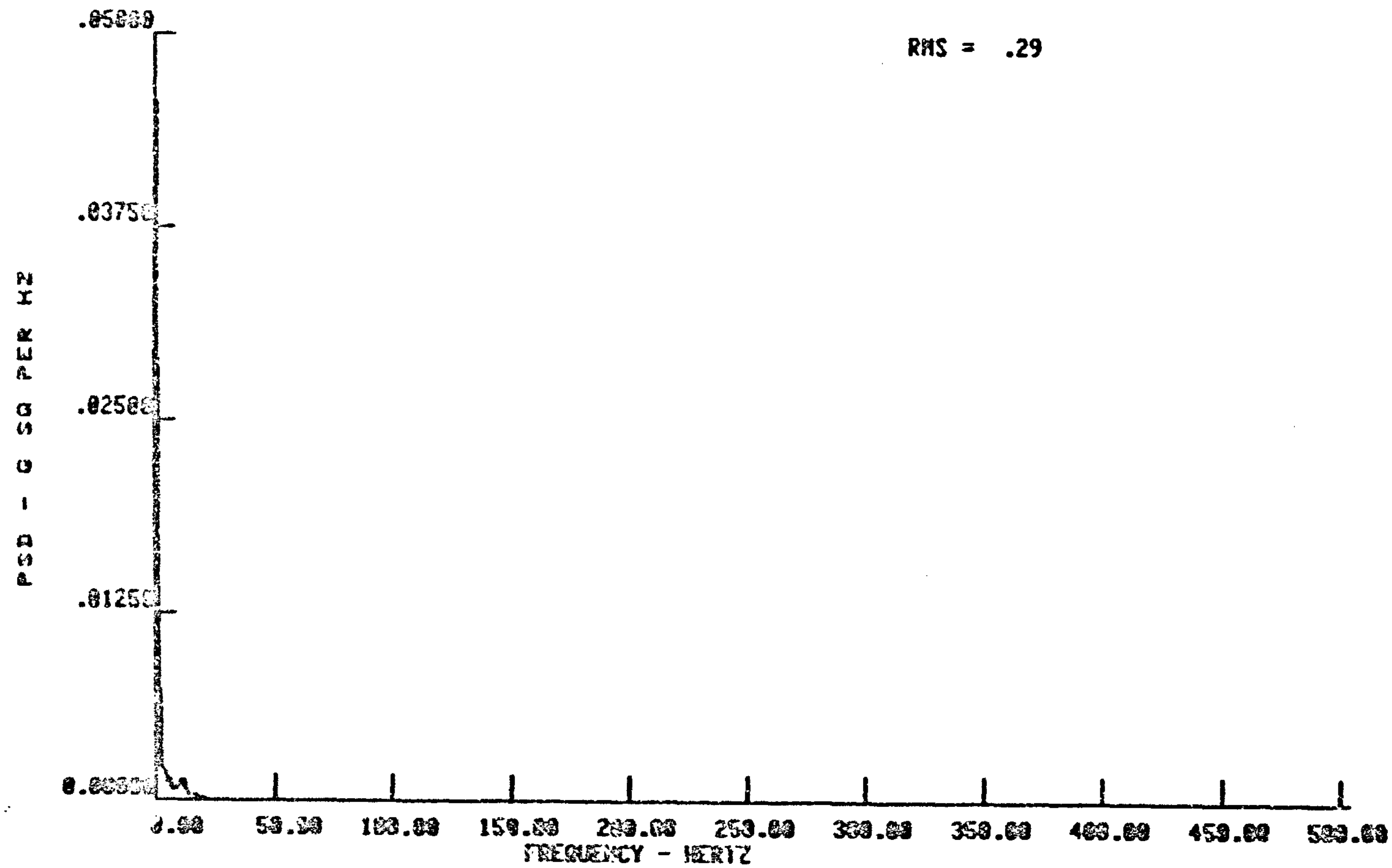


RUN 001 (T) COMPRESSOR TOP (AVE)
RMS = .59
.08000
.06000
.04000
.02000
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

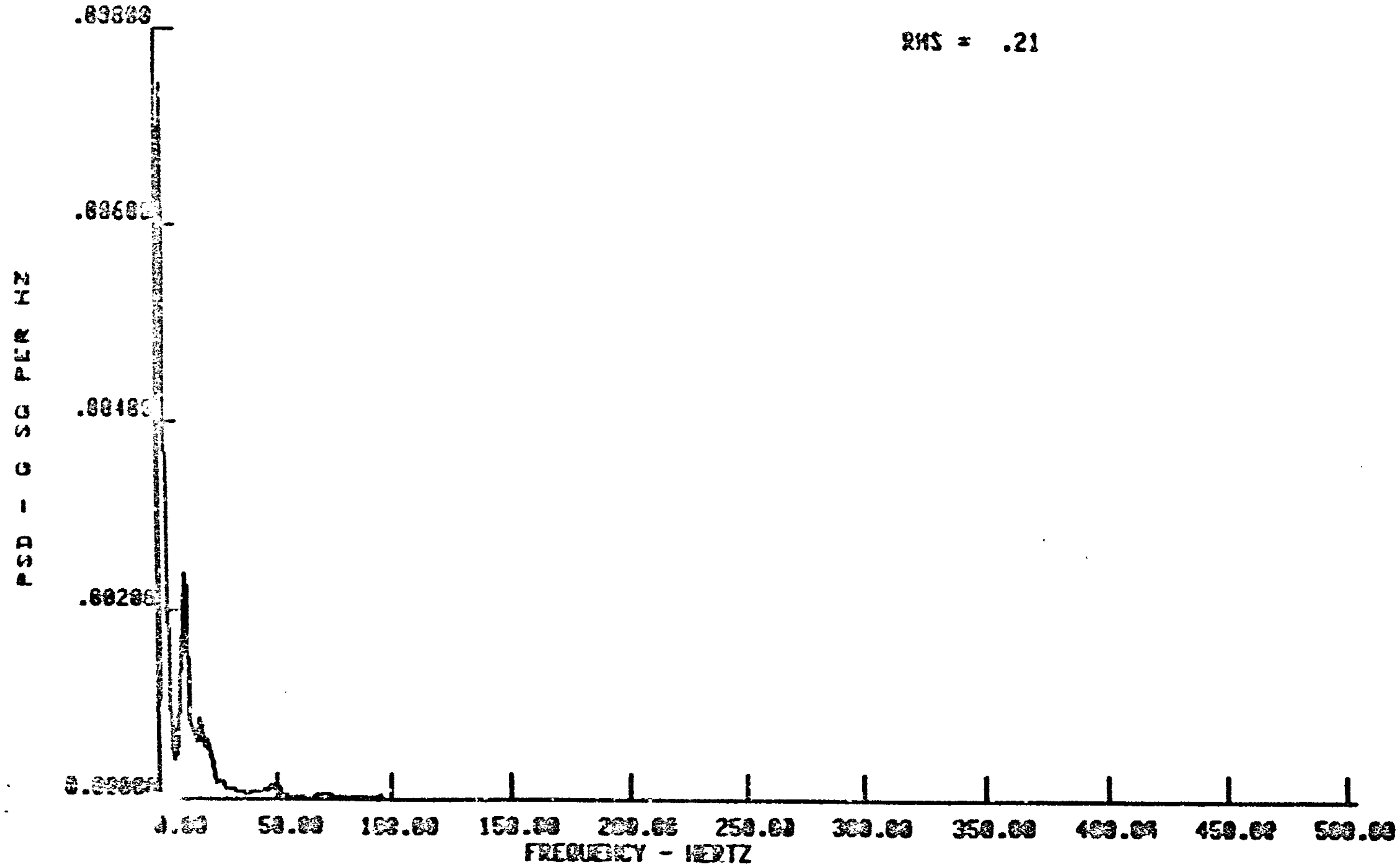

RUN 001 (L) COMPRESSOR TOP (AVE)
RMS = .20
.01500
.01125
.00750
.00375
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

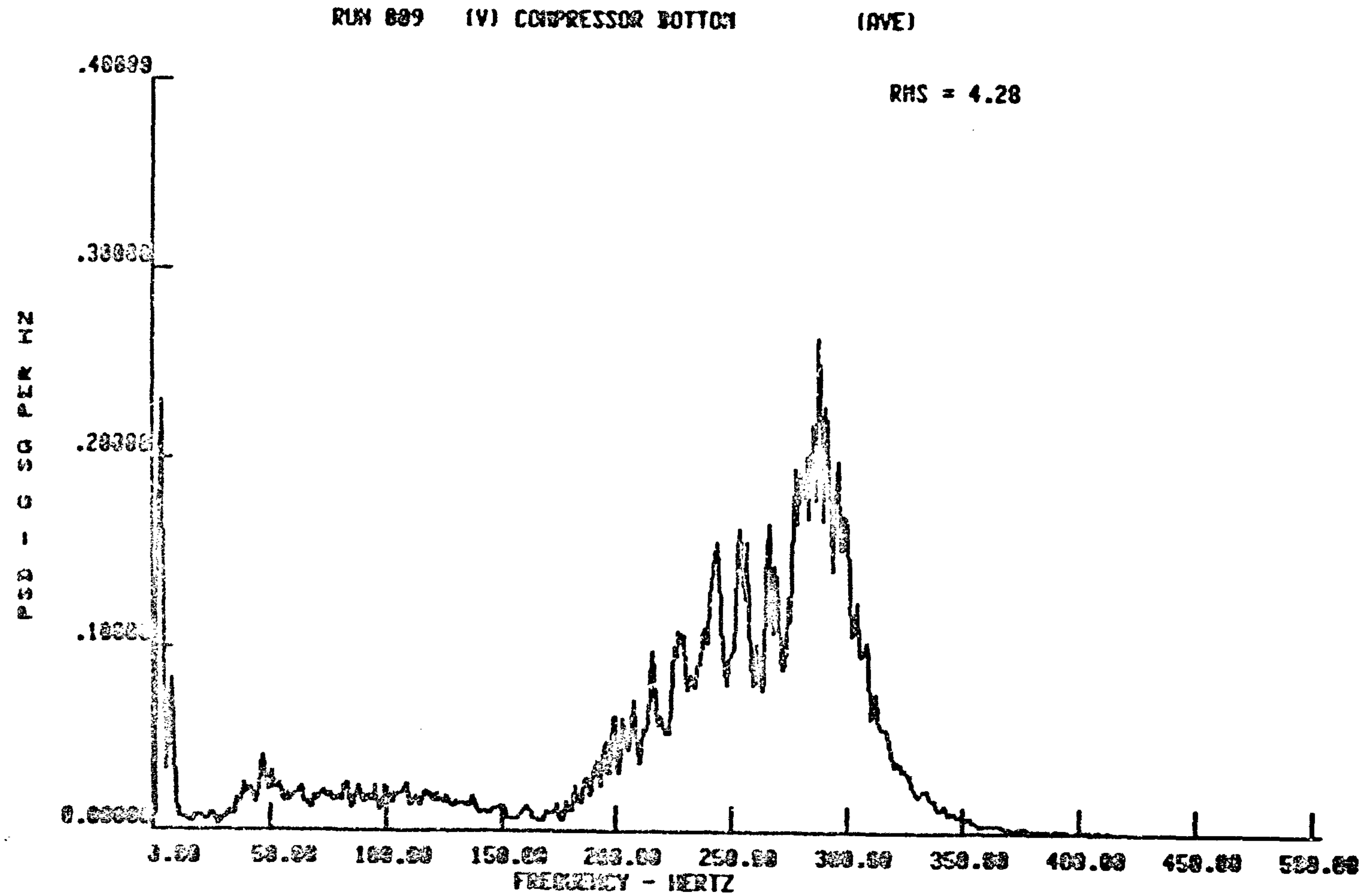

RUN 001 (V) AIR COND MOUNTING BRACKET (AVE)
RMS = .20
PSD - G SQ PER HZ
.00600
.00400
.00200
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

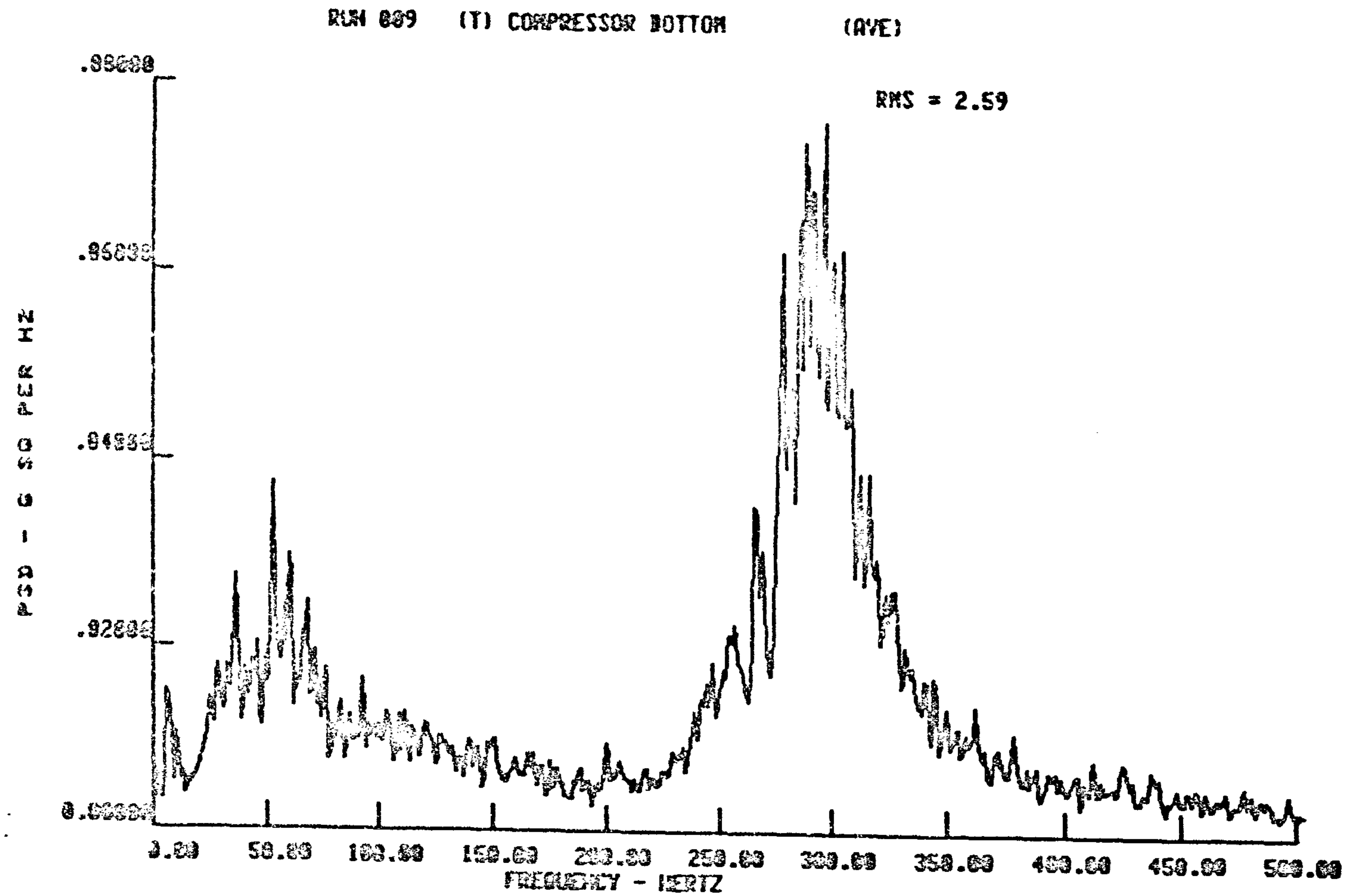
RUN 001 (T) AIR COMB MOUNTING BRACKET (AVE)



RUN 001 (L) AIR COND MOUNTING BRACKET (AVE)

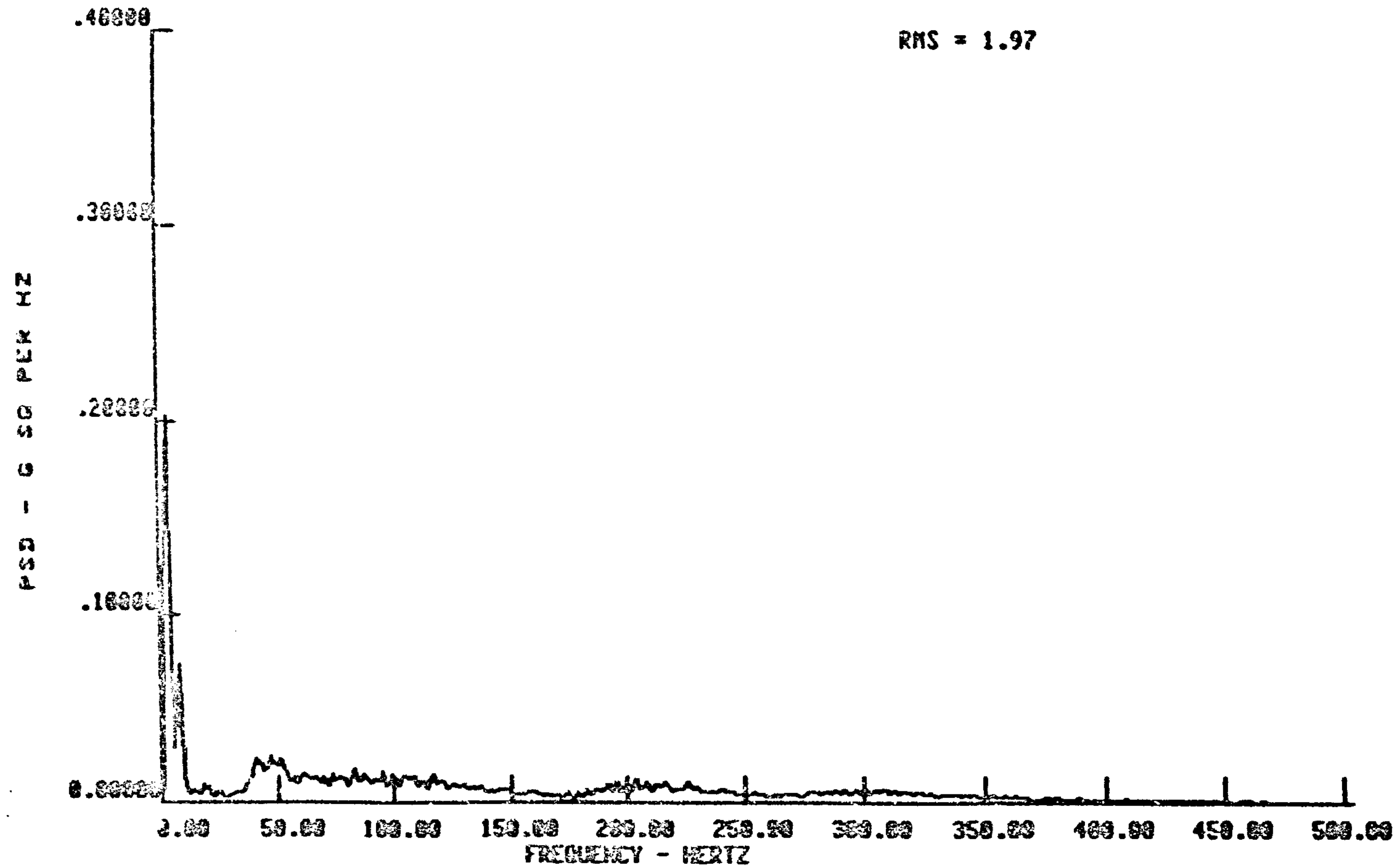


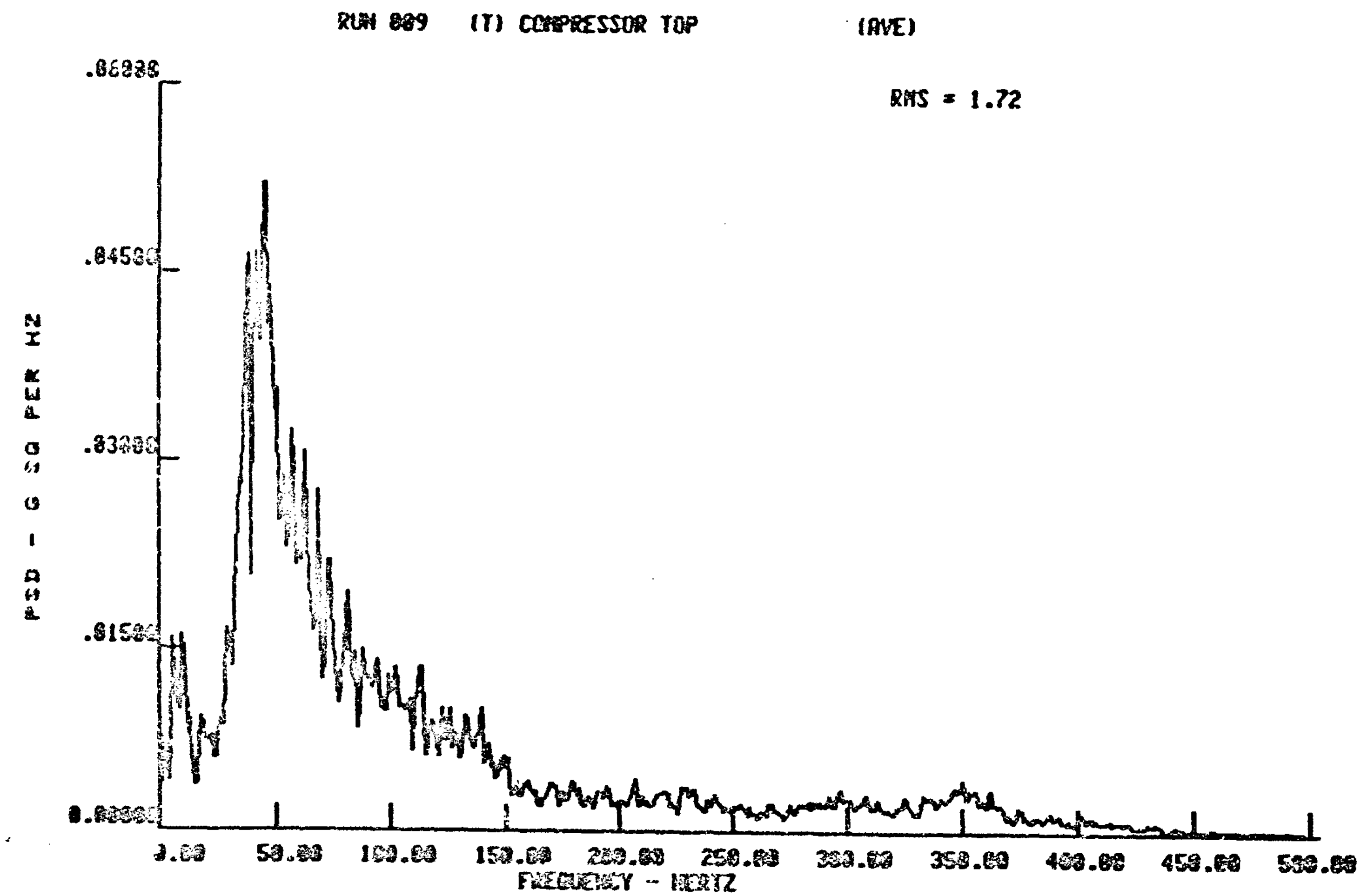

RUN 009 (V) COMPRESSOR BOTTOM (AVE)
RMS = 4.28
.40000
.30000
.20000
.10000
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

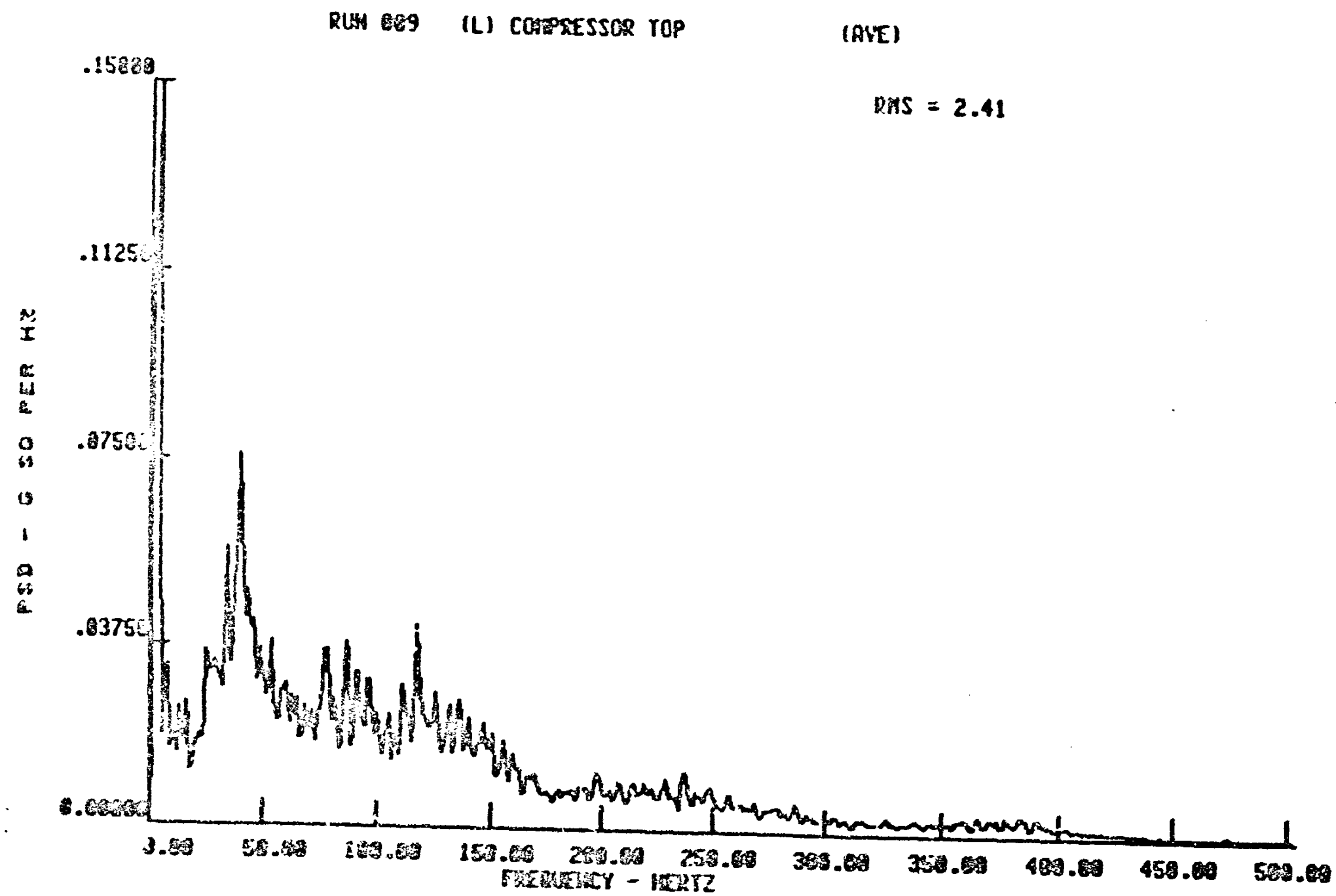

RUN 009 (T) COMPRESSOR BOTTOM (AVE)
RMS = 2.59
PSD - G SQ PER HZ
.08000
.06000
.04000
.02000
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

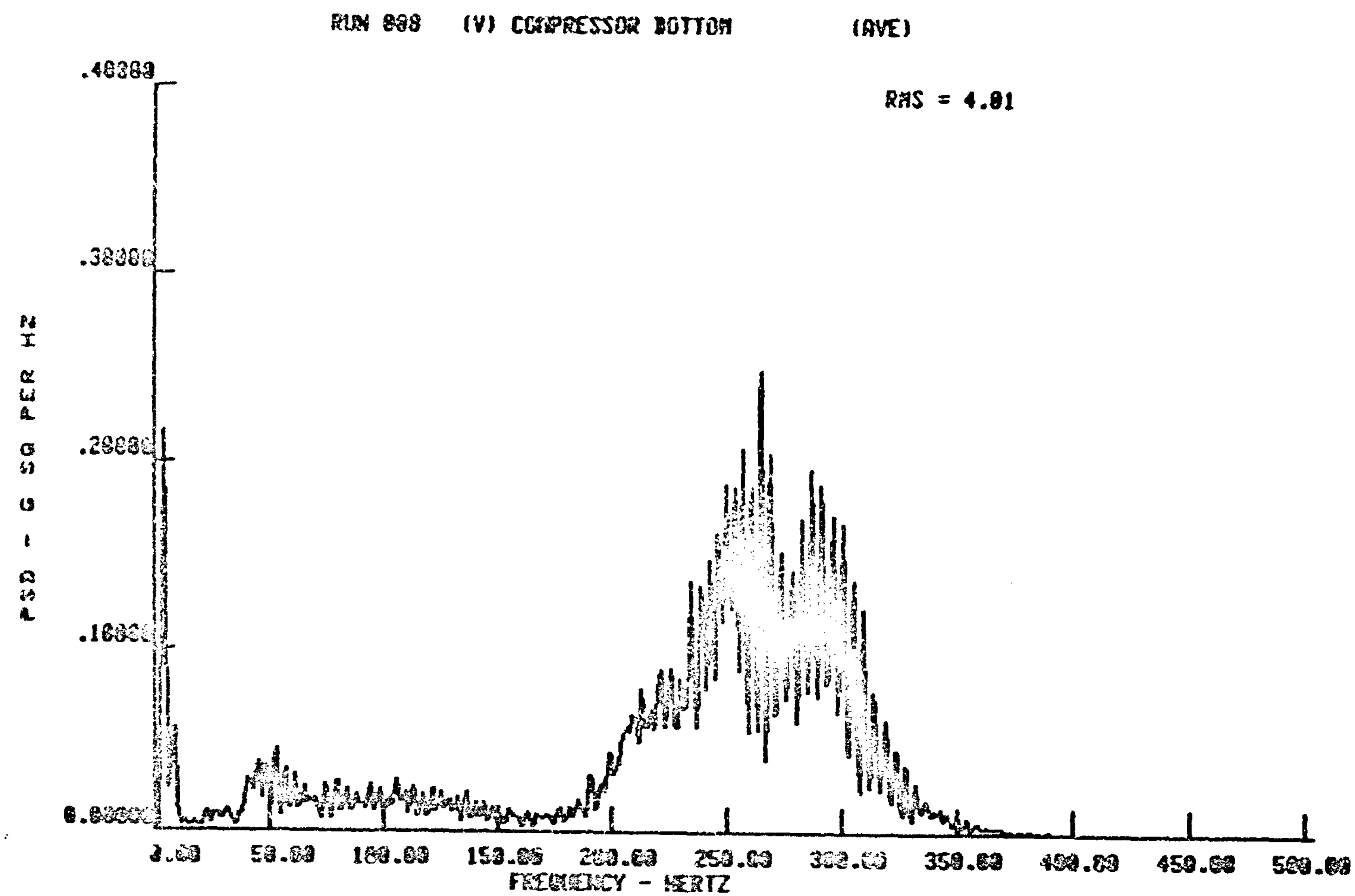

RUN 009 (L) COMPRESSOR BOTTOM (AVE)
RMS = 2.17
PSD - G SQ PER HZ
.15000
.11250
.07500
.03750
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

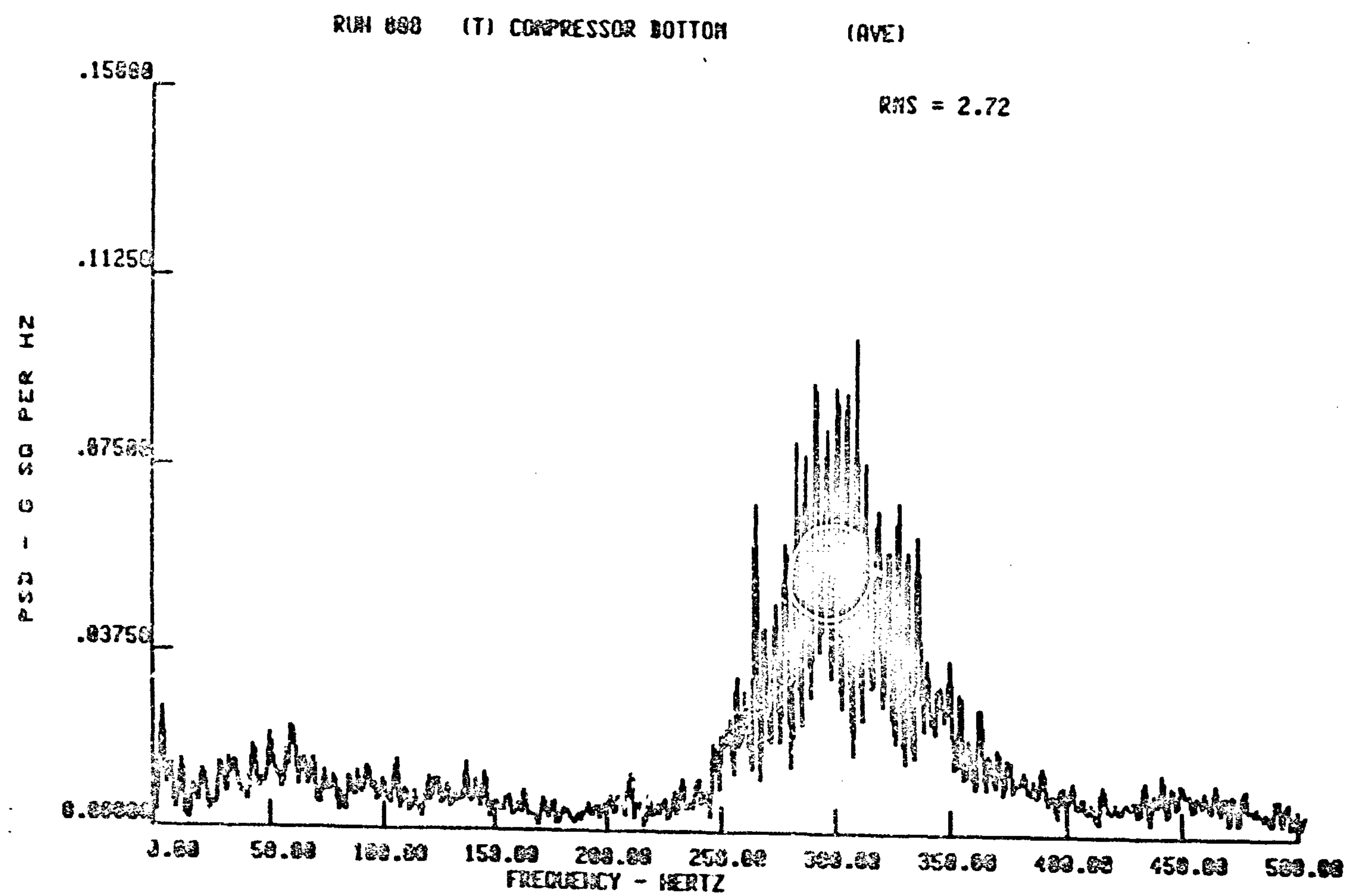
RUN 009 (V) COMPRESSOR TOP (AVE)



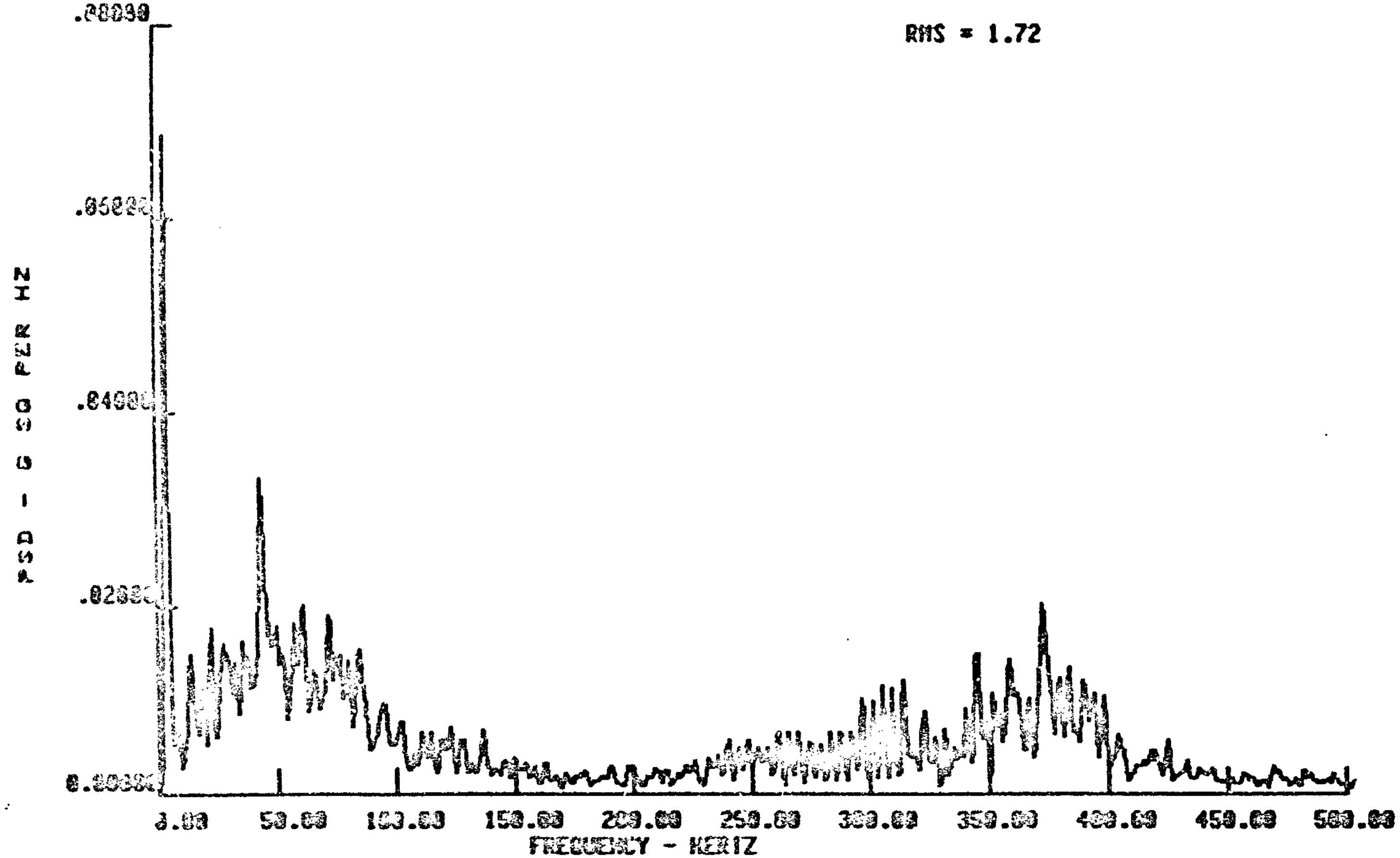

RUN 009 (T) COMPRESSOR TOP (AVE)
RMS = 1.72
PSD - G SQ PER HZ
.06000
.04500
.03000
.01500
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

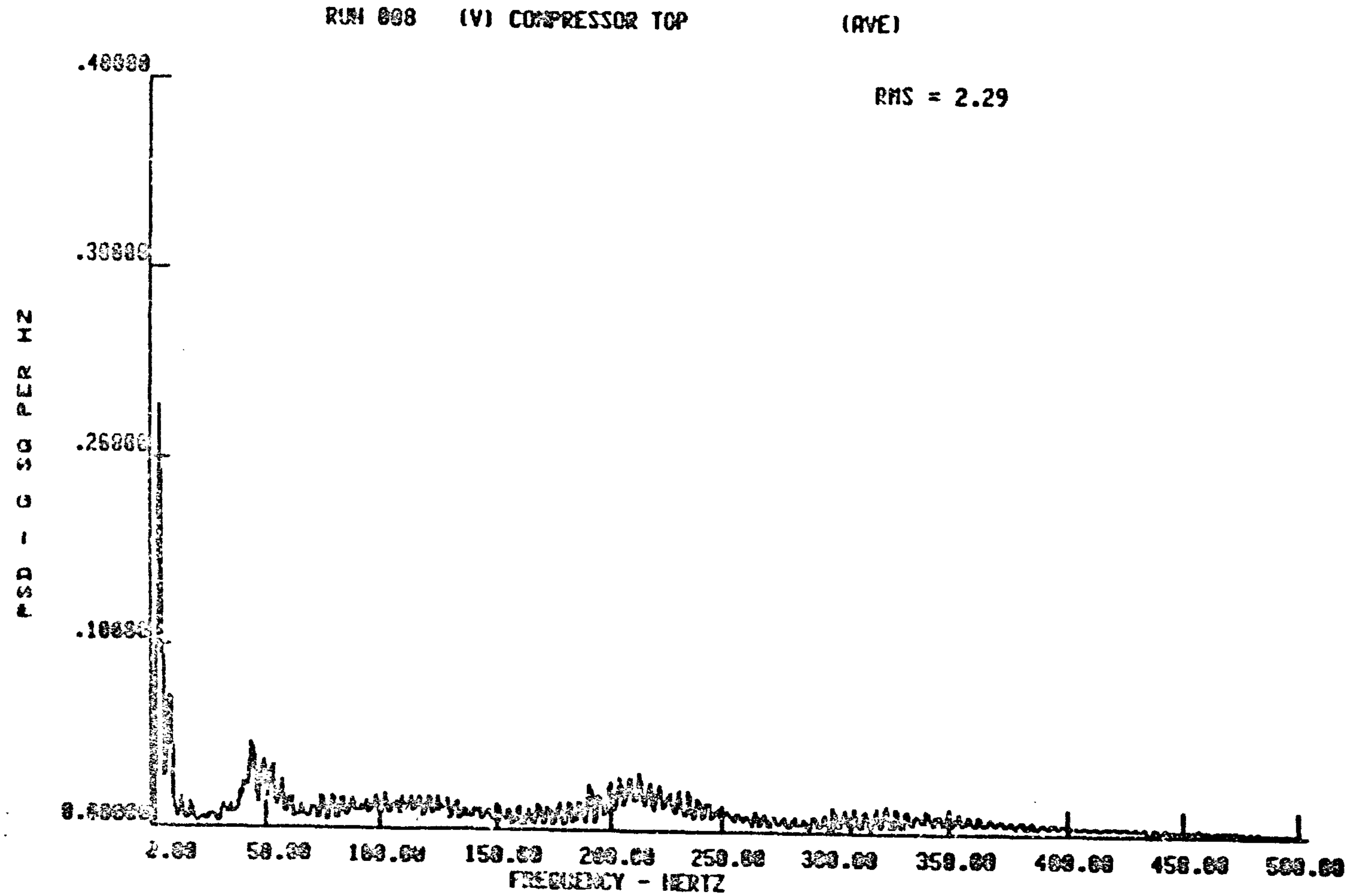

RUN 009 (L) COMPRESSOR TOP (AVE)
RMS = 2.41
.15000
.11250
.07500
.03750
0.00000
PSD - G SQ PER HZ
3.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

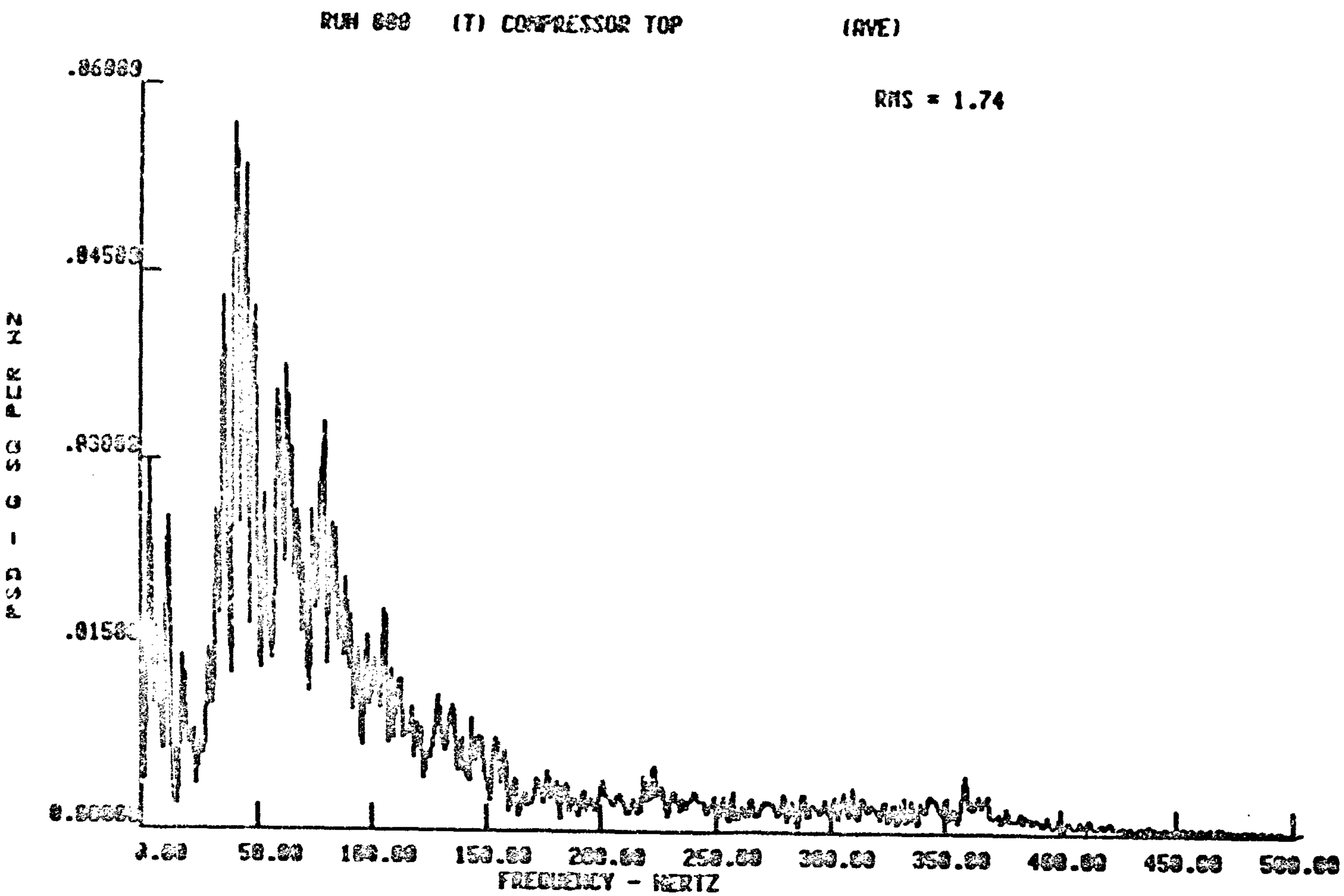

RUN 808 (V) COMPRESSOR BOTTOM (AVE)
RMS = 4.01
.40000
.30000
.20000
.10000
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

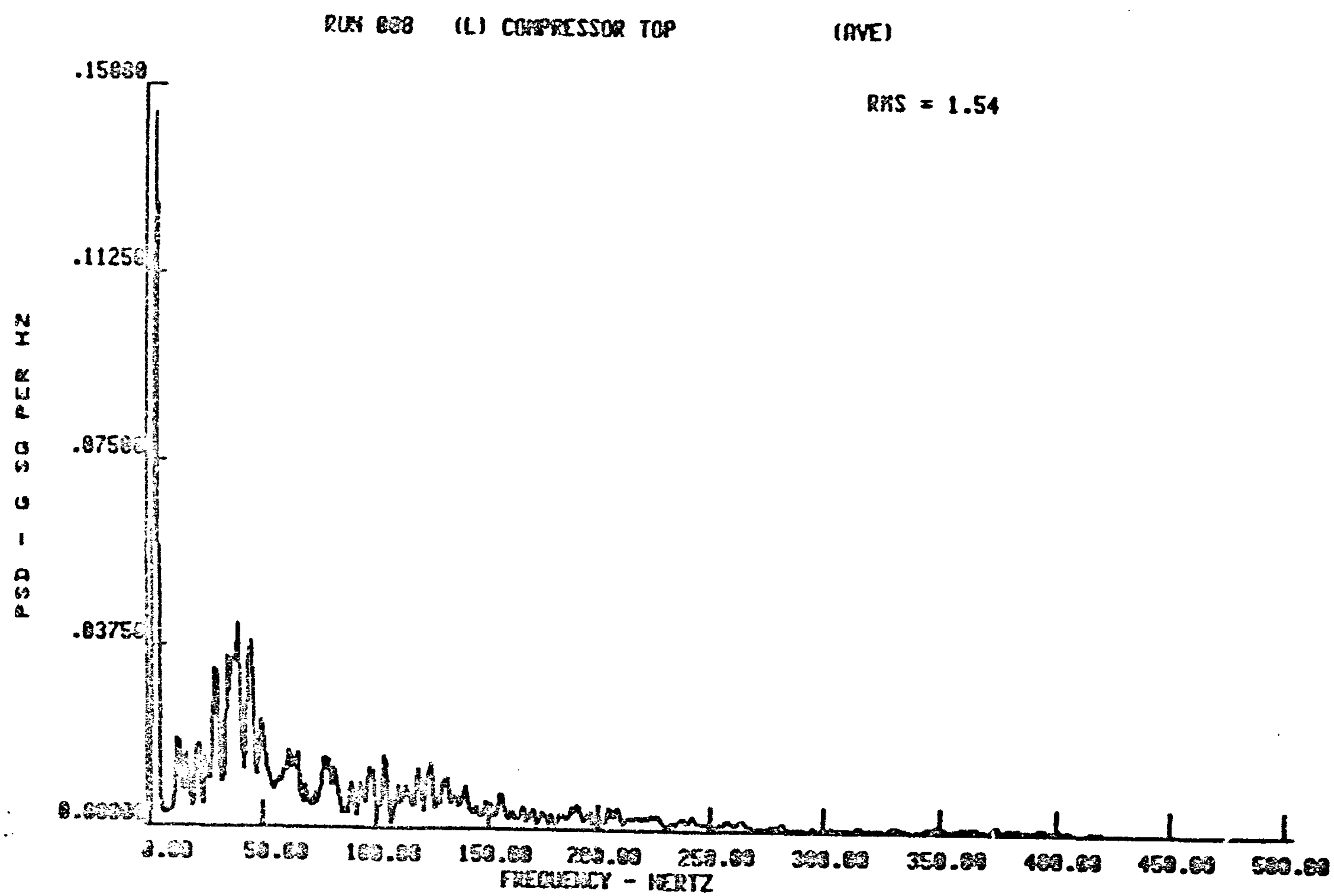

RUN 888 (T) COMPRESSOR BOTTOM (AVE)
RMS = 2.72
PSD - G SQ PER HZ
.15000
.11250
.07500
.03750
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

RUN 603 (L) COMPRESSOR BOTTOM (AVE)



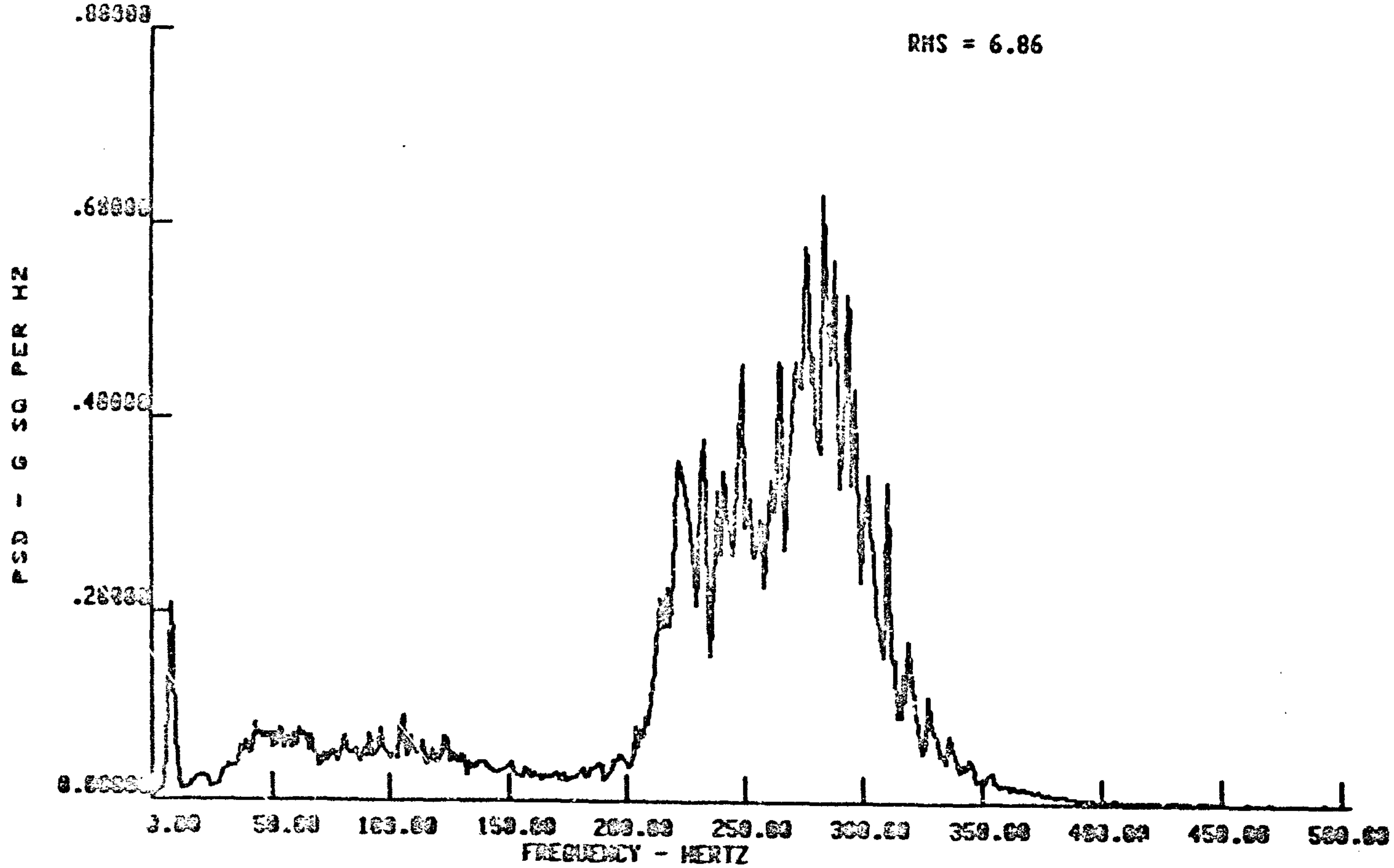

RUN 008 (V) COMPRESSOR TOP (AVE)
RMS = 2.29
PSD - G SQ PER HZ
.40000
.30000
.20000
.10000
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

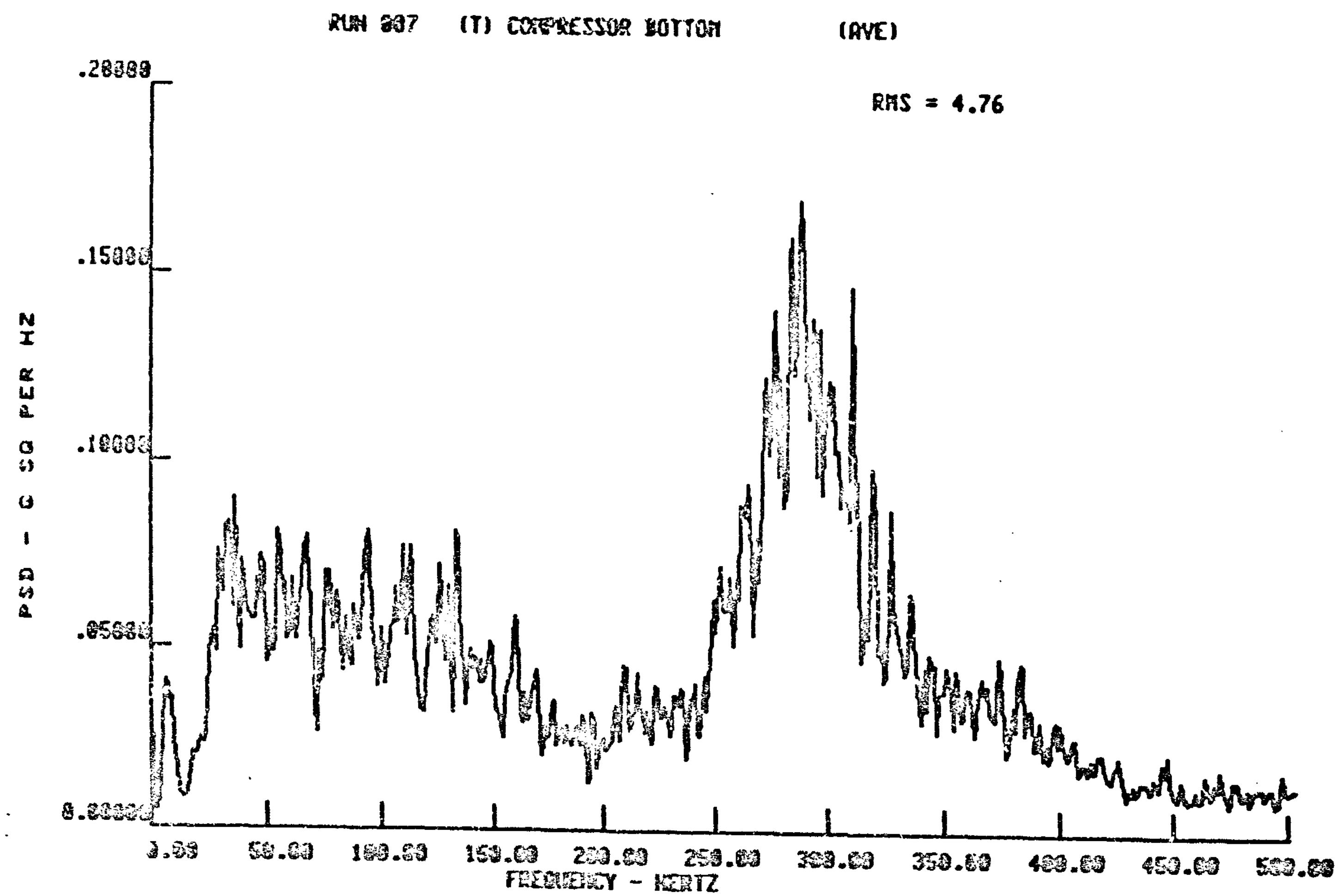

RUN 600 (T) COMPRESSOR TOP (AVE)
RMS = 1.74
PSD - G SQ PER HZ
.06000
.04500
.03000
.01500
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ



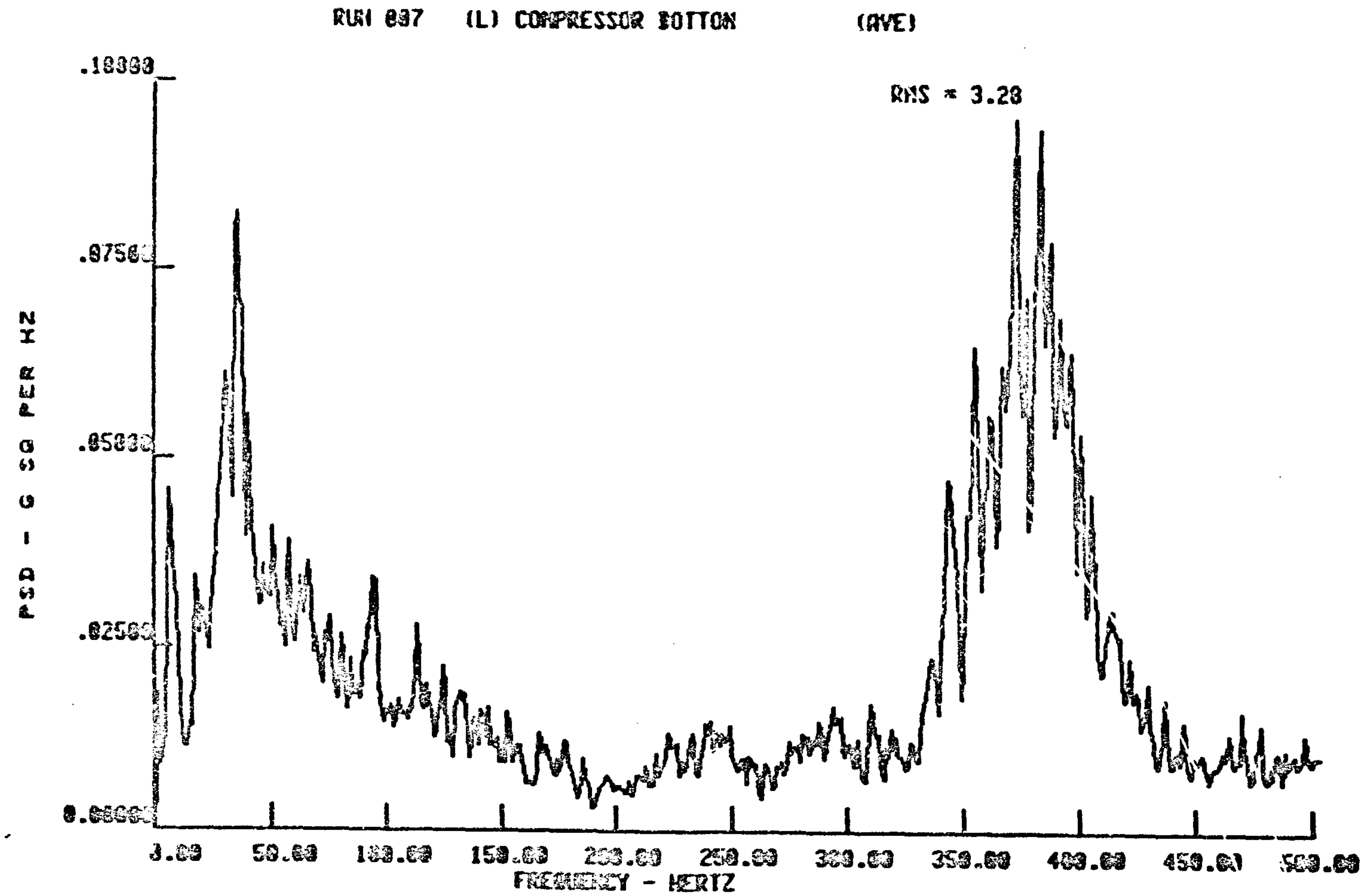
RUN 008 (L) COMPRESSOR TOP (AVE)
RMS = 1.54
.15000
.11250
.07500
.03750
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

RUN 037 (V) COMPRESSOR BOTTOM (AVE)

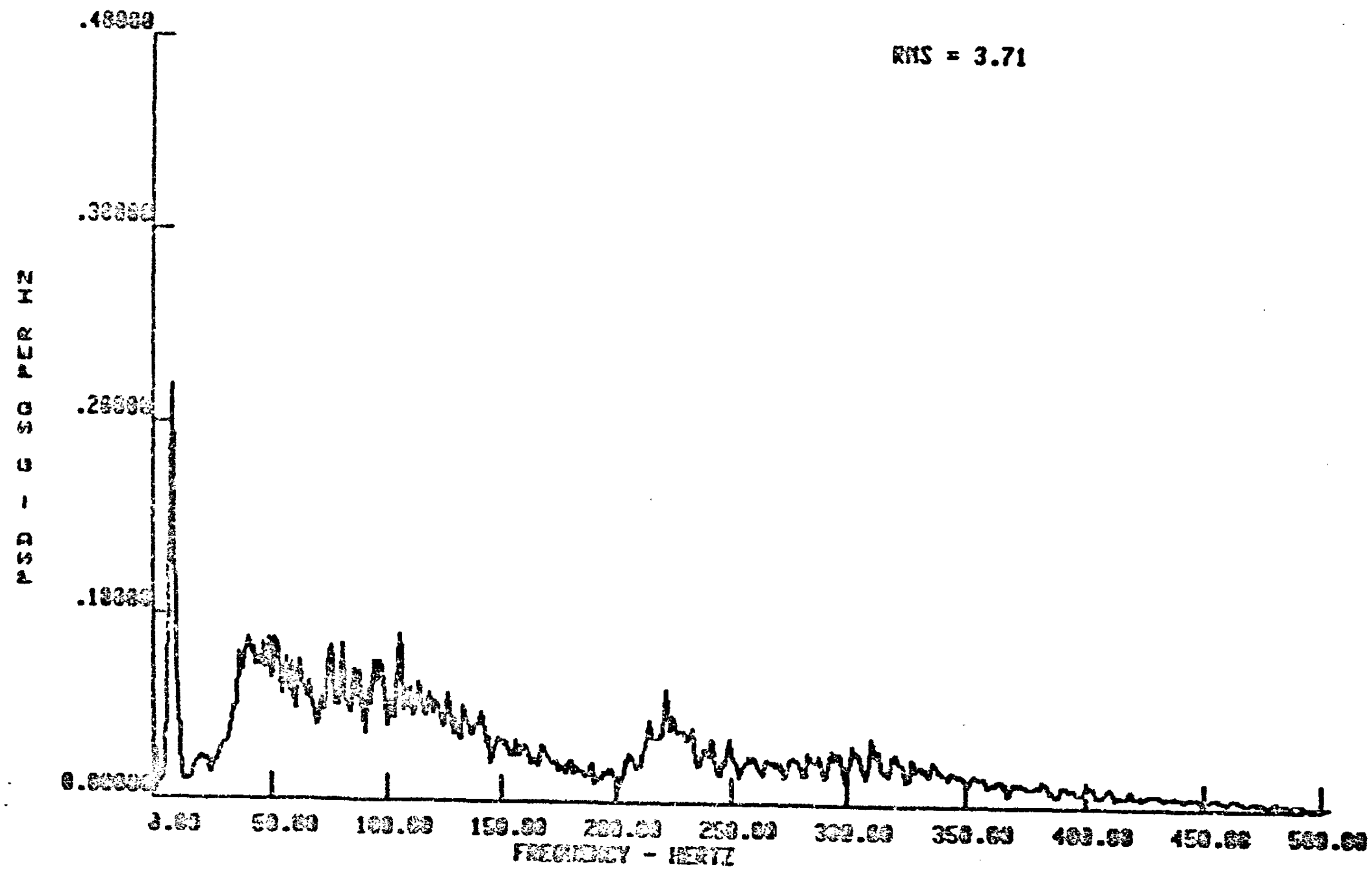


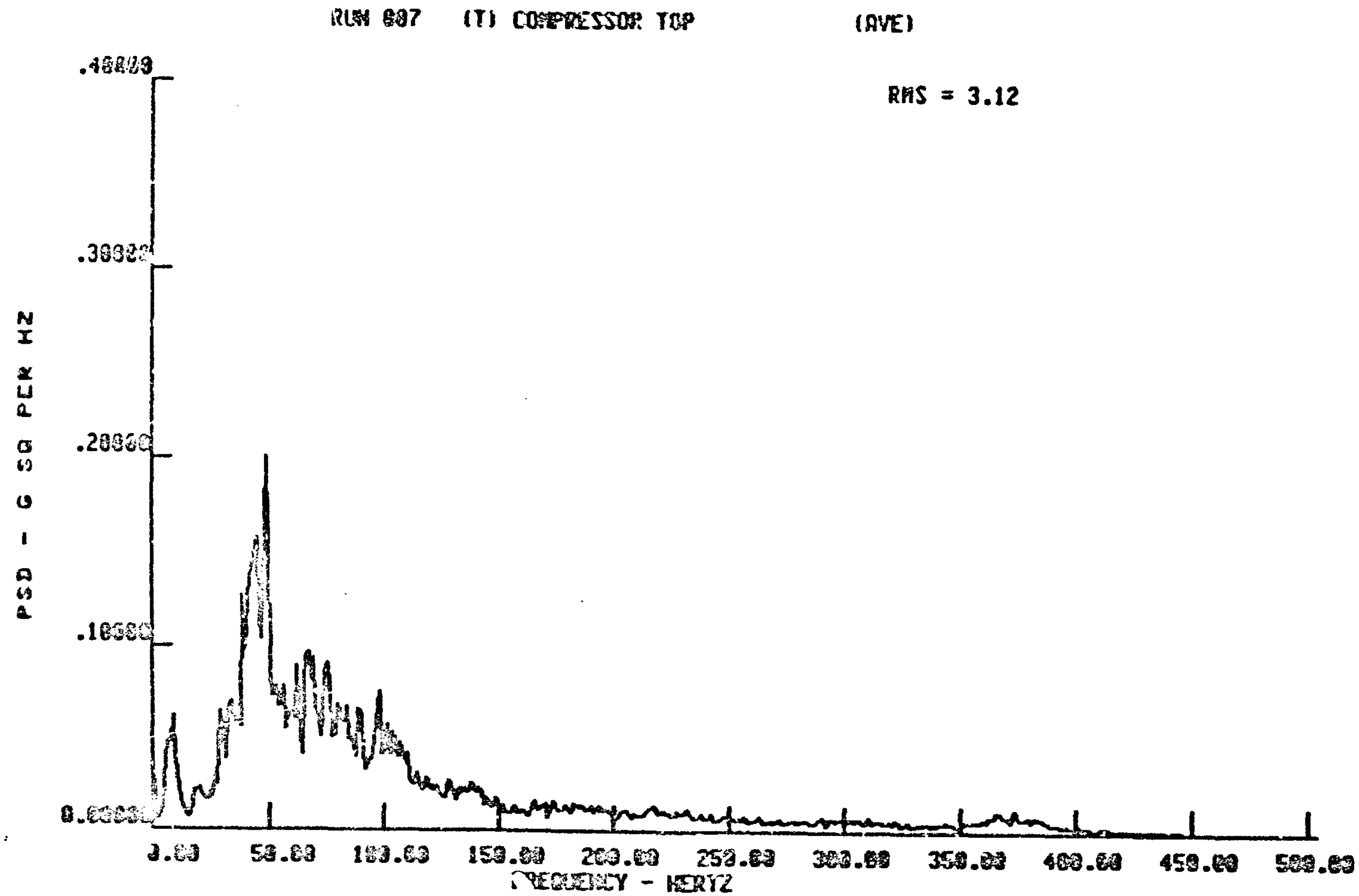


RUN 007 (T) COMPRESSOR BOTTOM (AVE)
RMS = 4.76
.20000
.15000
.10000
.05000
0.00000
PSD - G SQ PER HZ
3.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

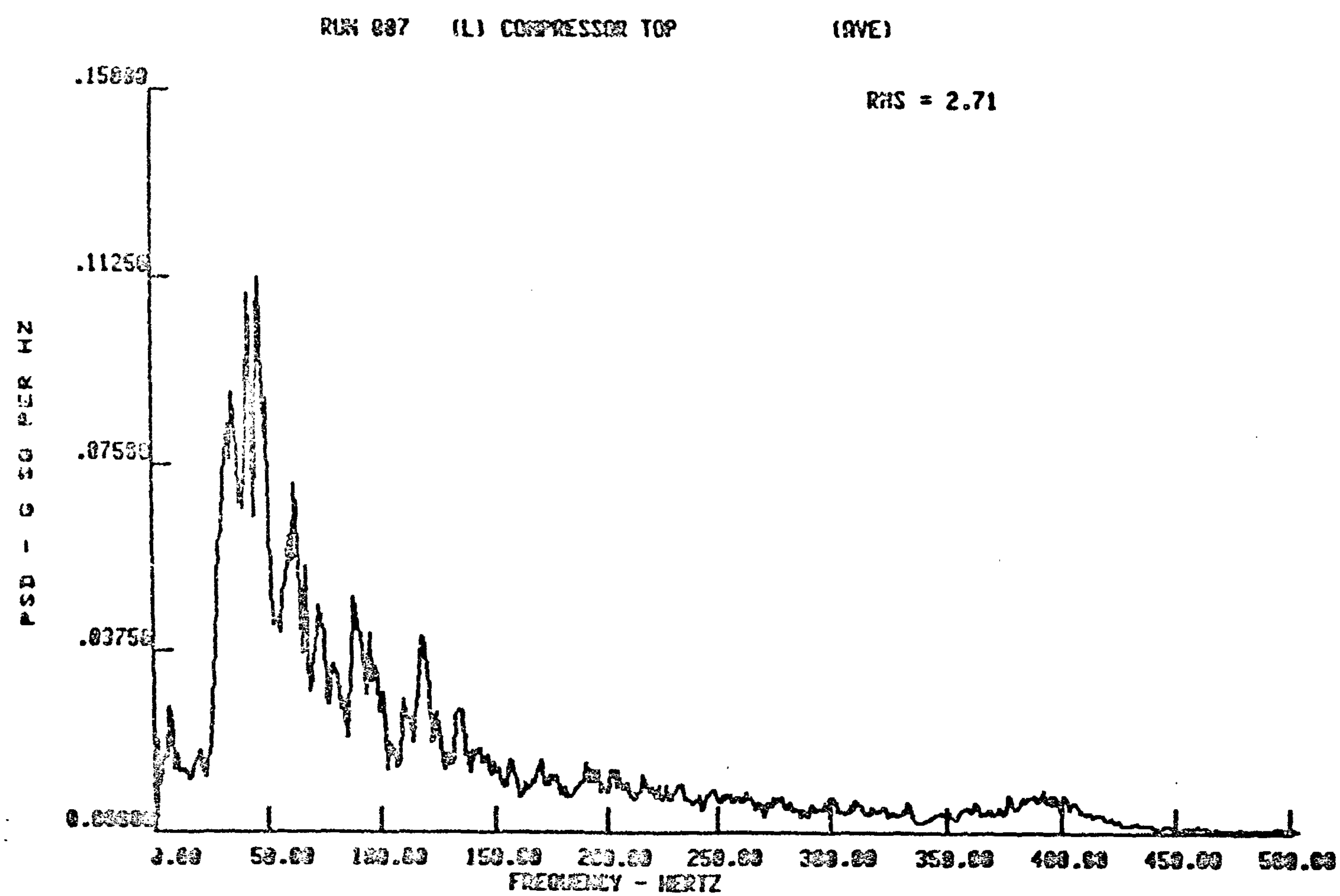

RUN 037 (L) COMPRESSOR BOTTOM (AVE)
RMS = 3.28
PSD - G SQ PER HZ
.10000
.07500
.05000
.02500
0.00000
3.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

RUN 007 (V) COMPRESSOR TOP (AVE)



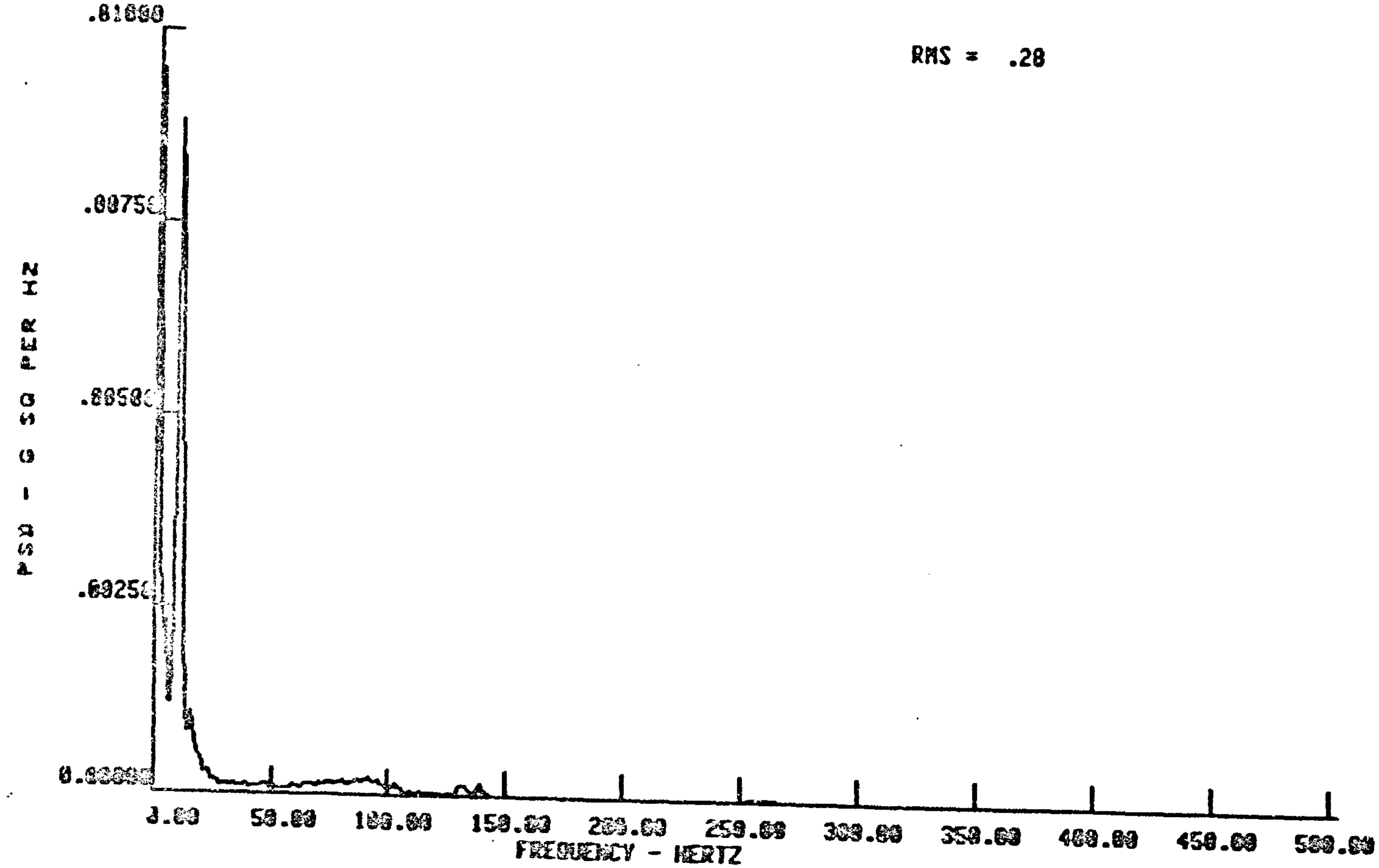


RUN 007 (T) COMPRESSOR TOP (AVE)
RMS = 3.12
PSD - G SQ PER HZ
.40000
.30000
.20000
.10000
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

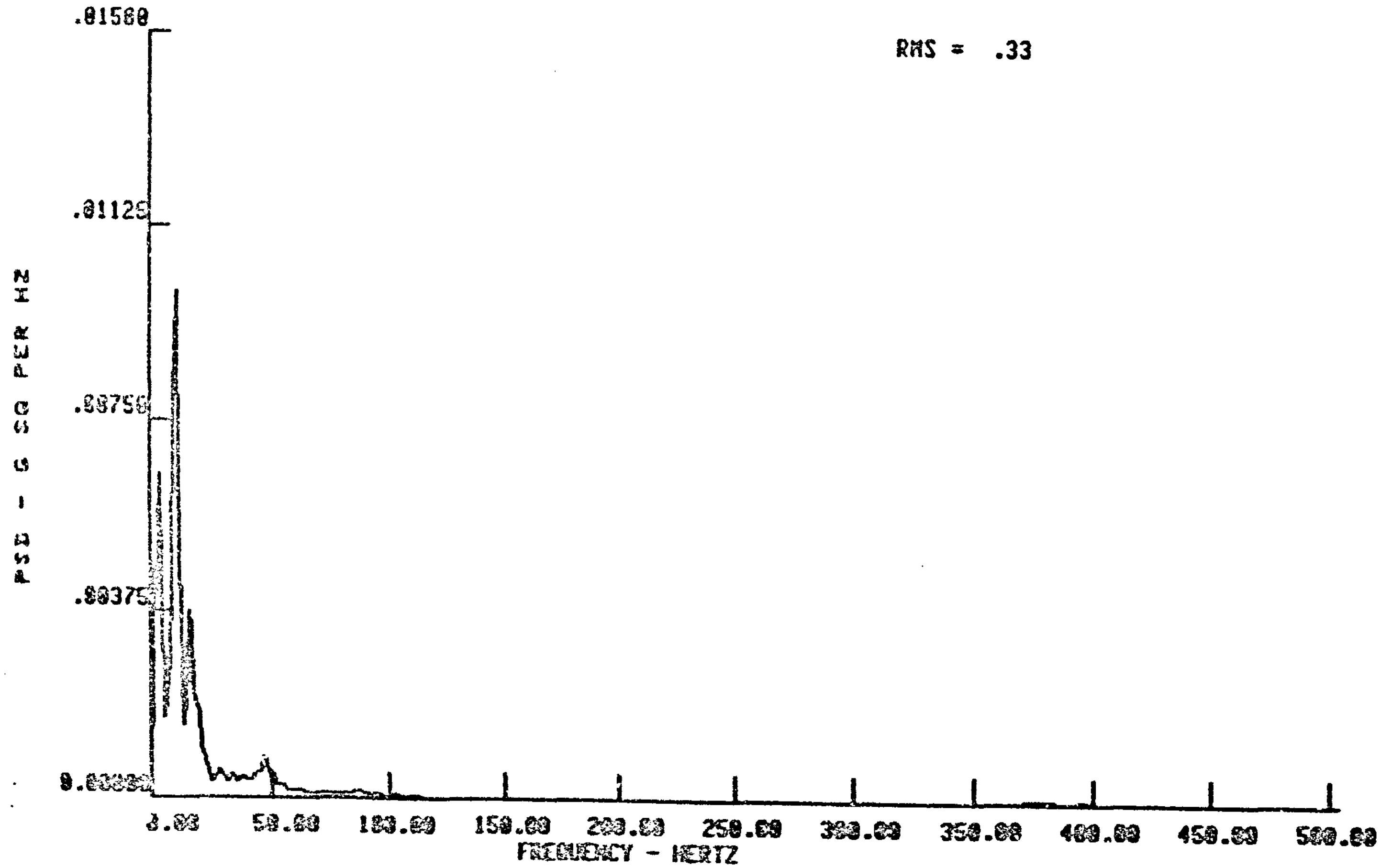


RUN 087 (L) COMPRESSOR TOP (AVE)
RMS = 2.71
.15000
.11250
.07500
.03750
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

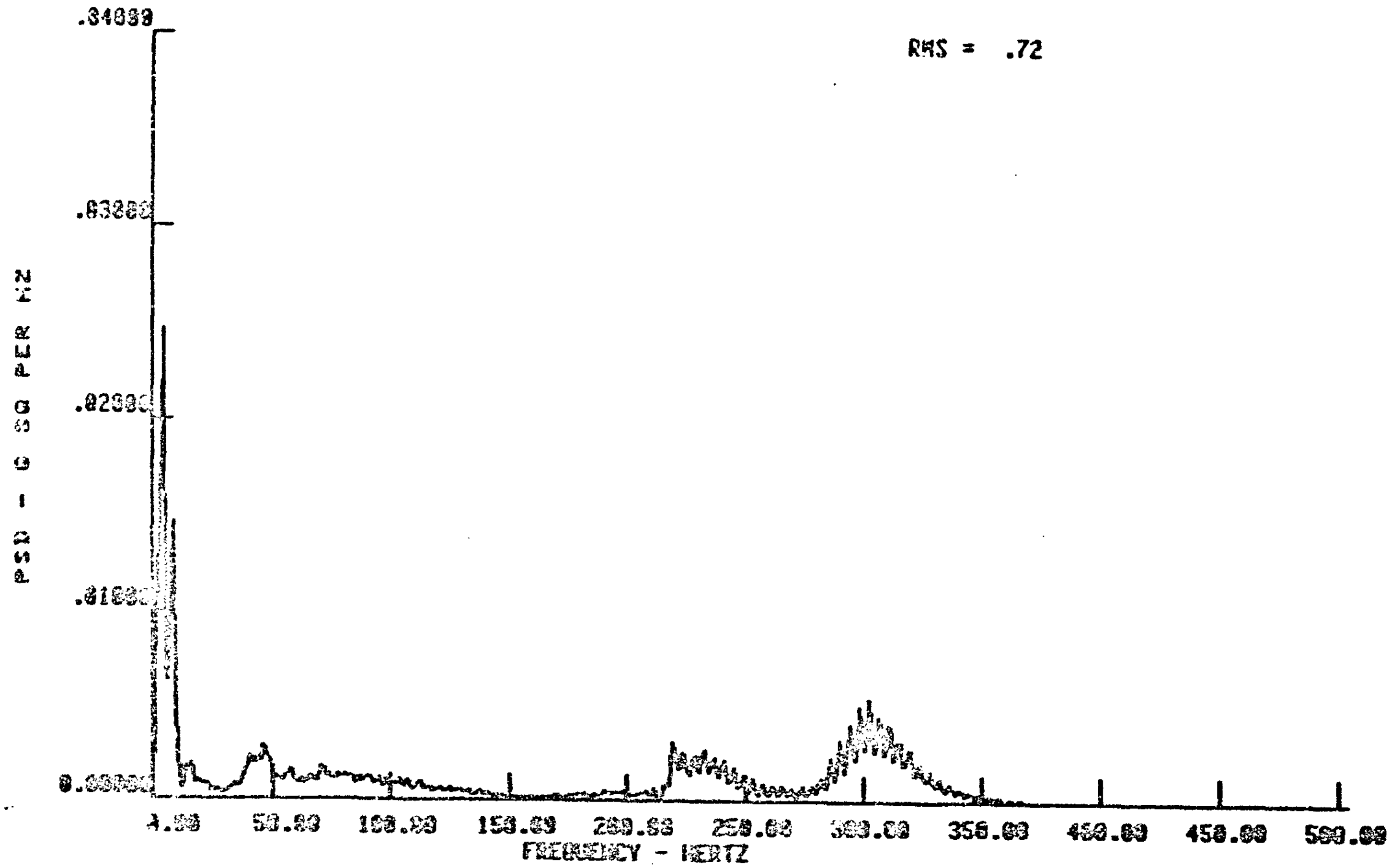
RUN 003 (T) AIR COND MOUNTING BRACKET (AVE)

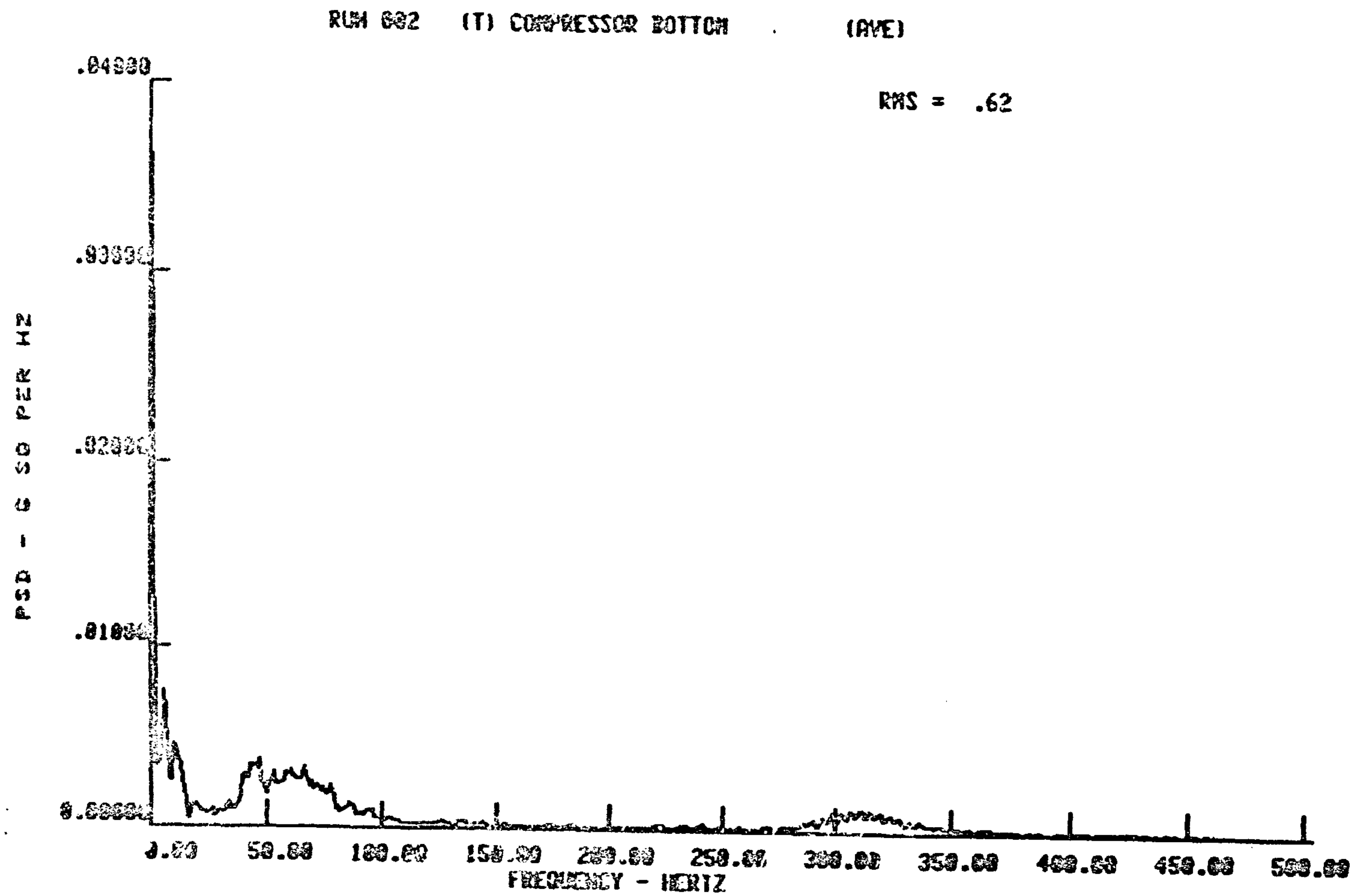


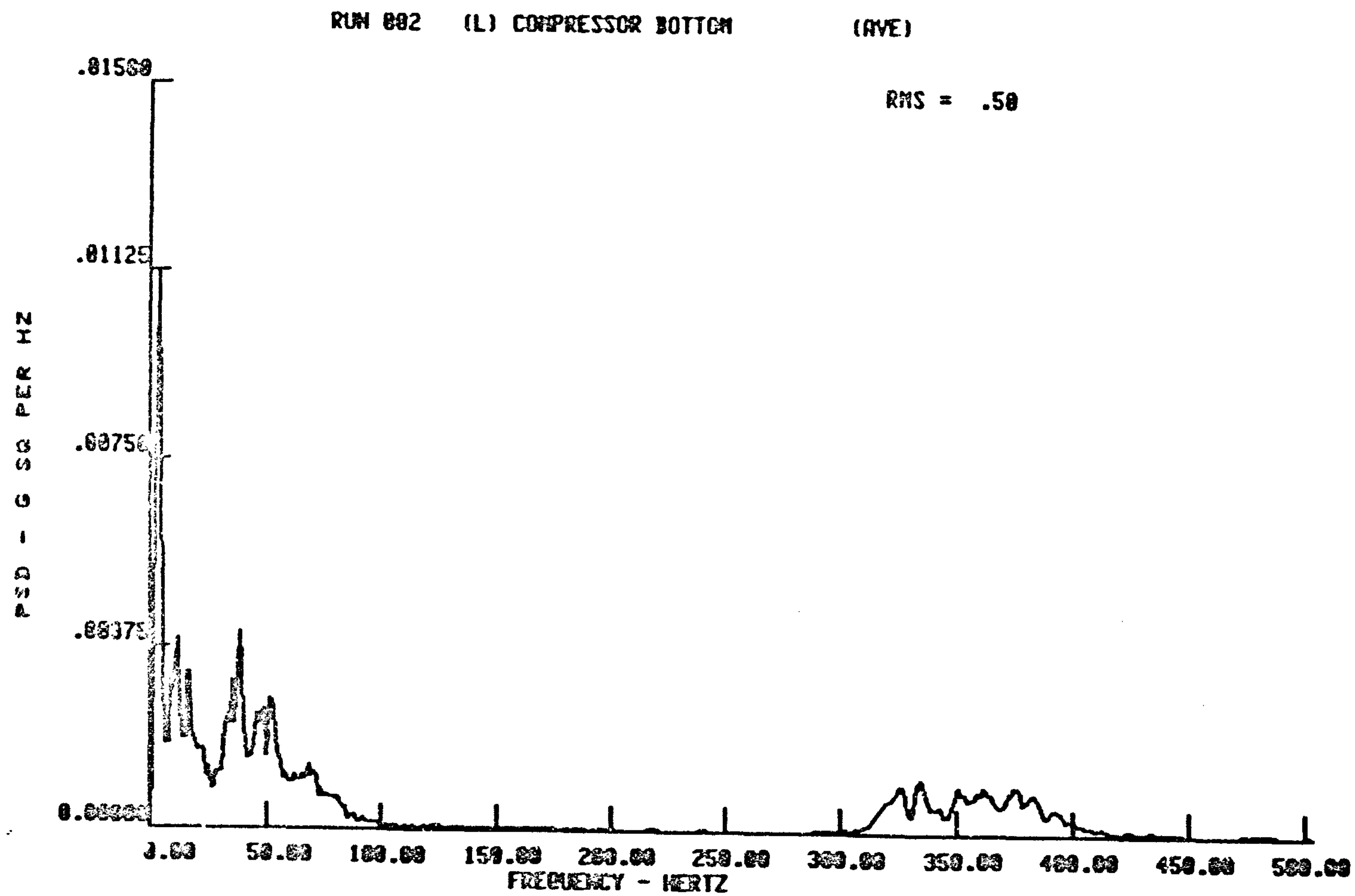
RUN 003 (L) AIR COND MOUNTING BRACKET (AVE)

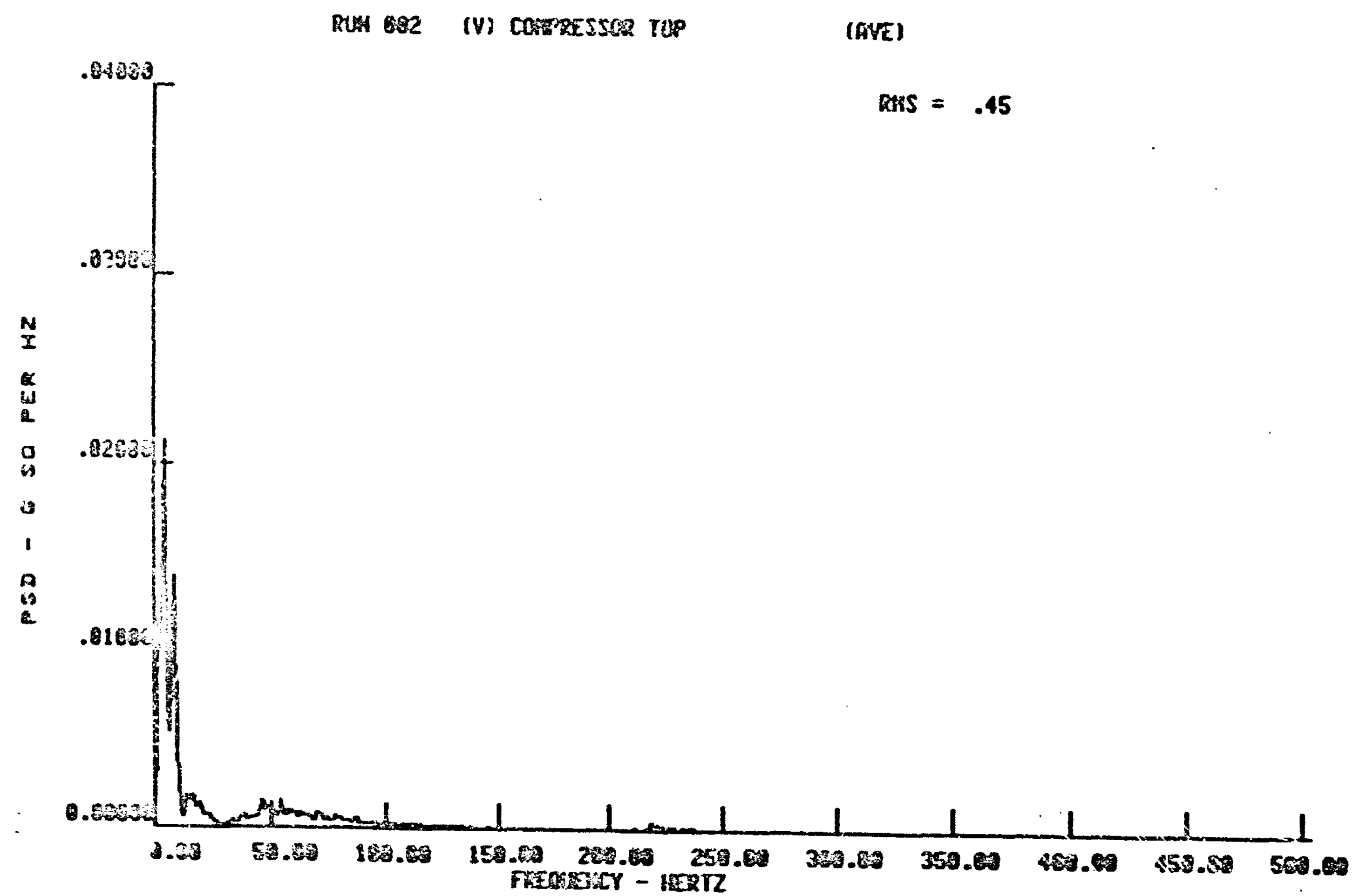


RUN 002 (V) COMPRESSOR BOTTOM (AVE)

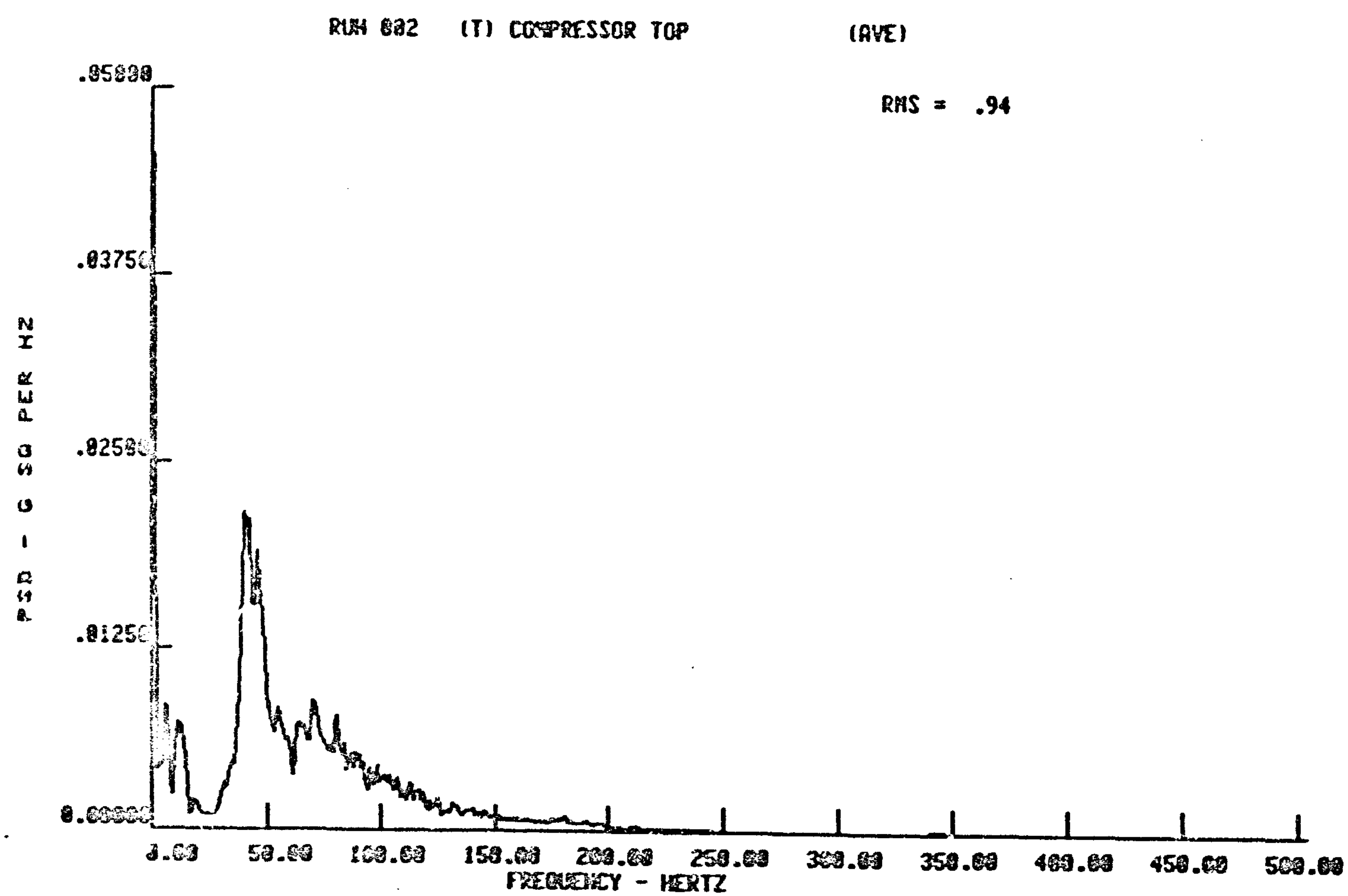



RUN 002 (T) COMPRESSOR BOTTOM (AVE)
RMS = .62
.04000
.03000
.02000
.01000
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

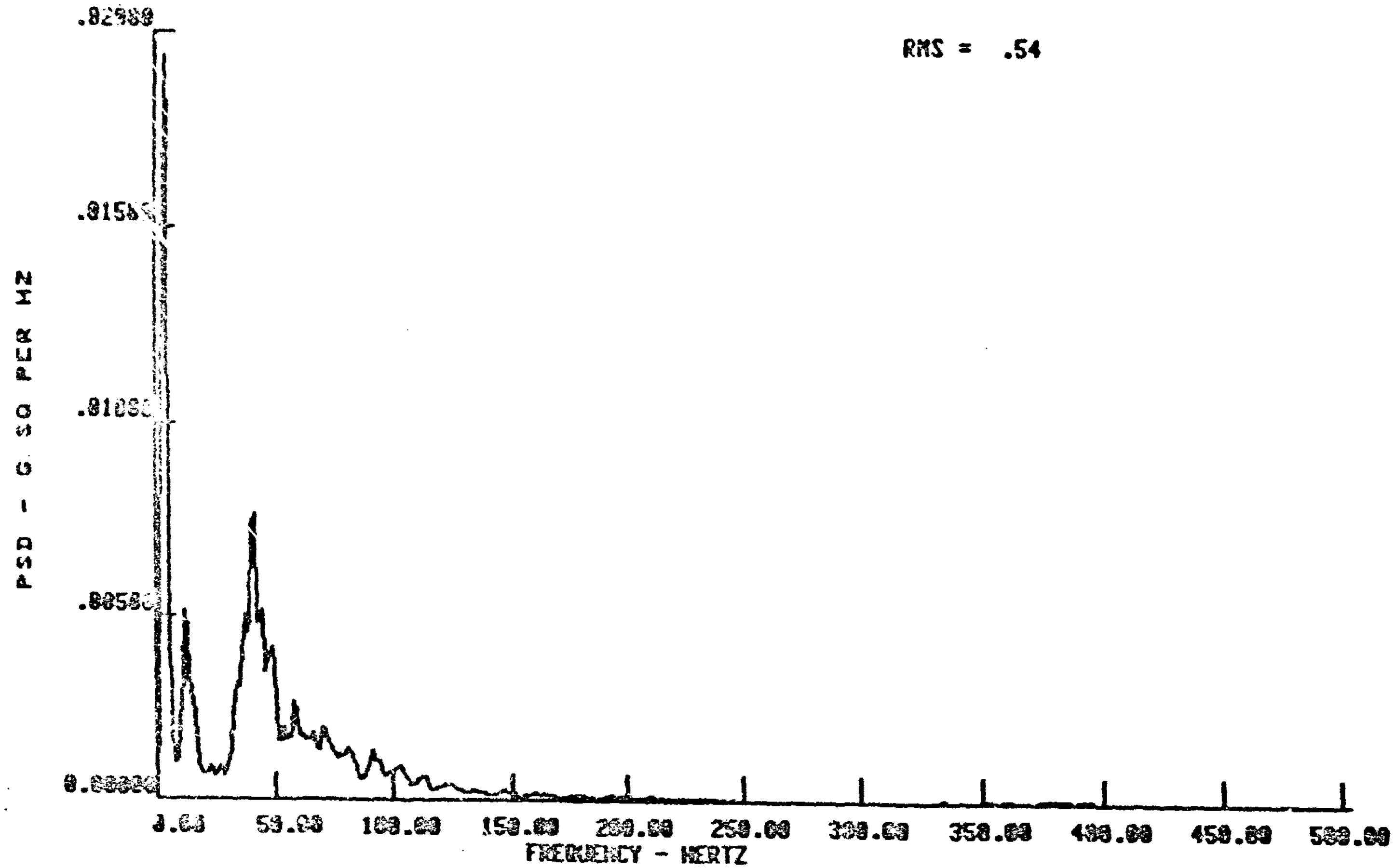

RUN 002 (L) COMPRESSOR BOTTOM (AVE)
RMS = .50
.01500
.01125
.00750
.00375
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ



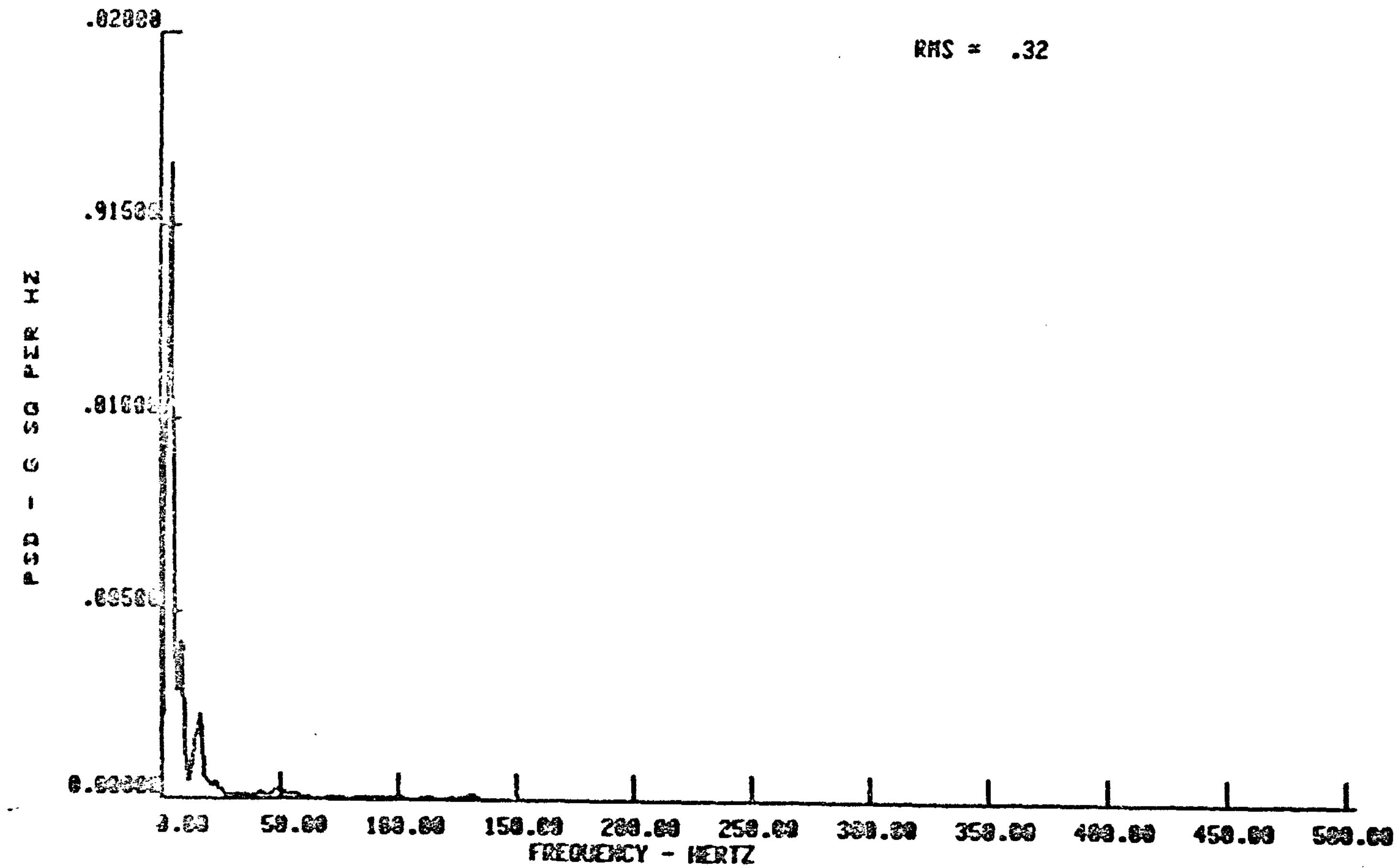
RUN 002 (V) COMPRESSOR TOP (AVE)
RMS = .45
.04000
.03000
.02000
.01000
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

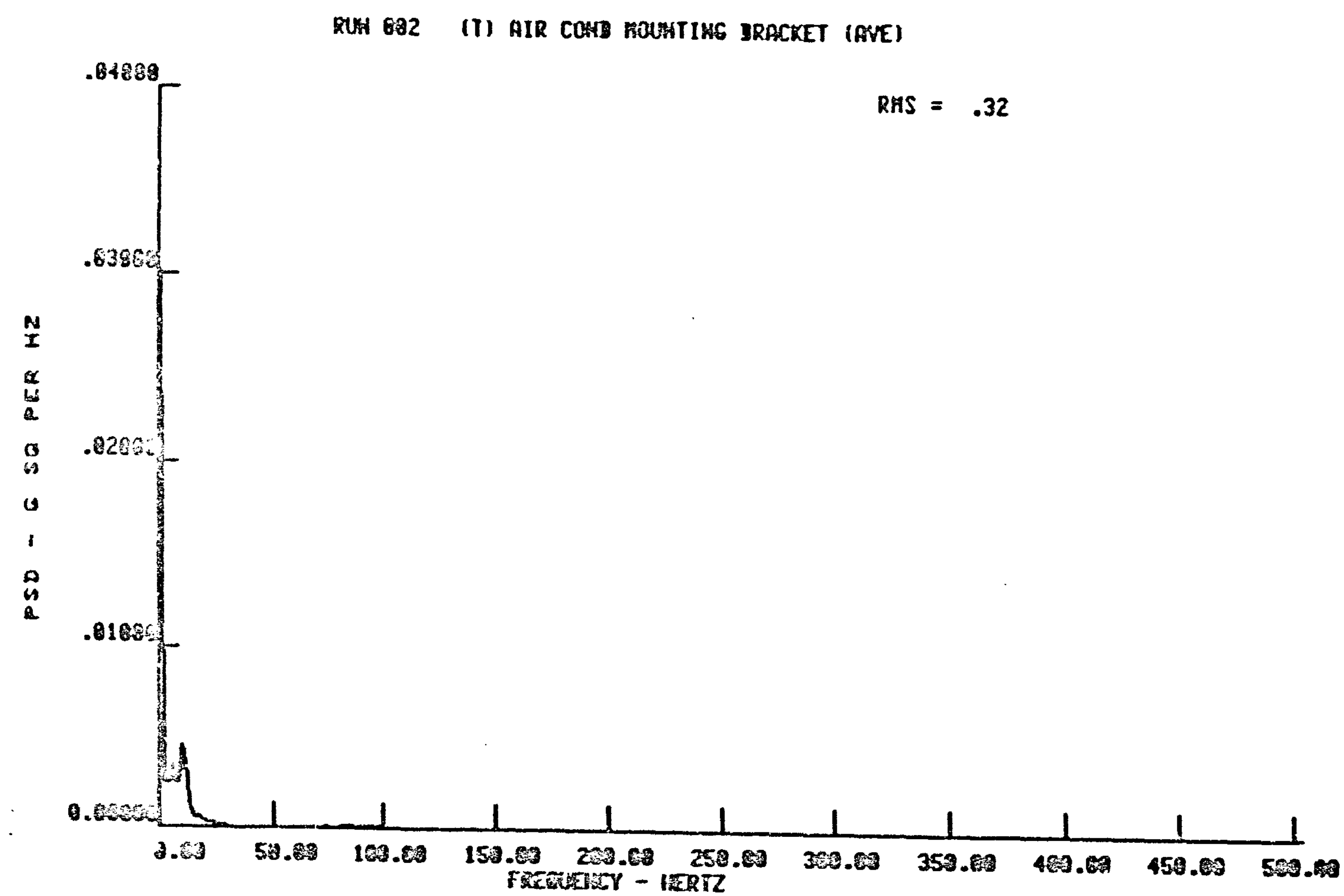

RUN 002 (T) COMPRESSOR TOP (AVE)
RMS = .94
.05000
.03750
.02500
.01250
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

RUN 002 (L) COMPRESSOR TOP (AVE)

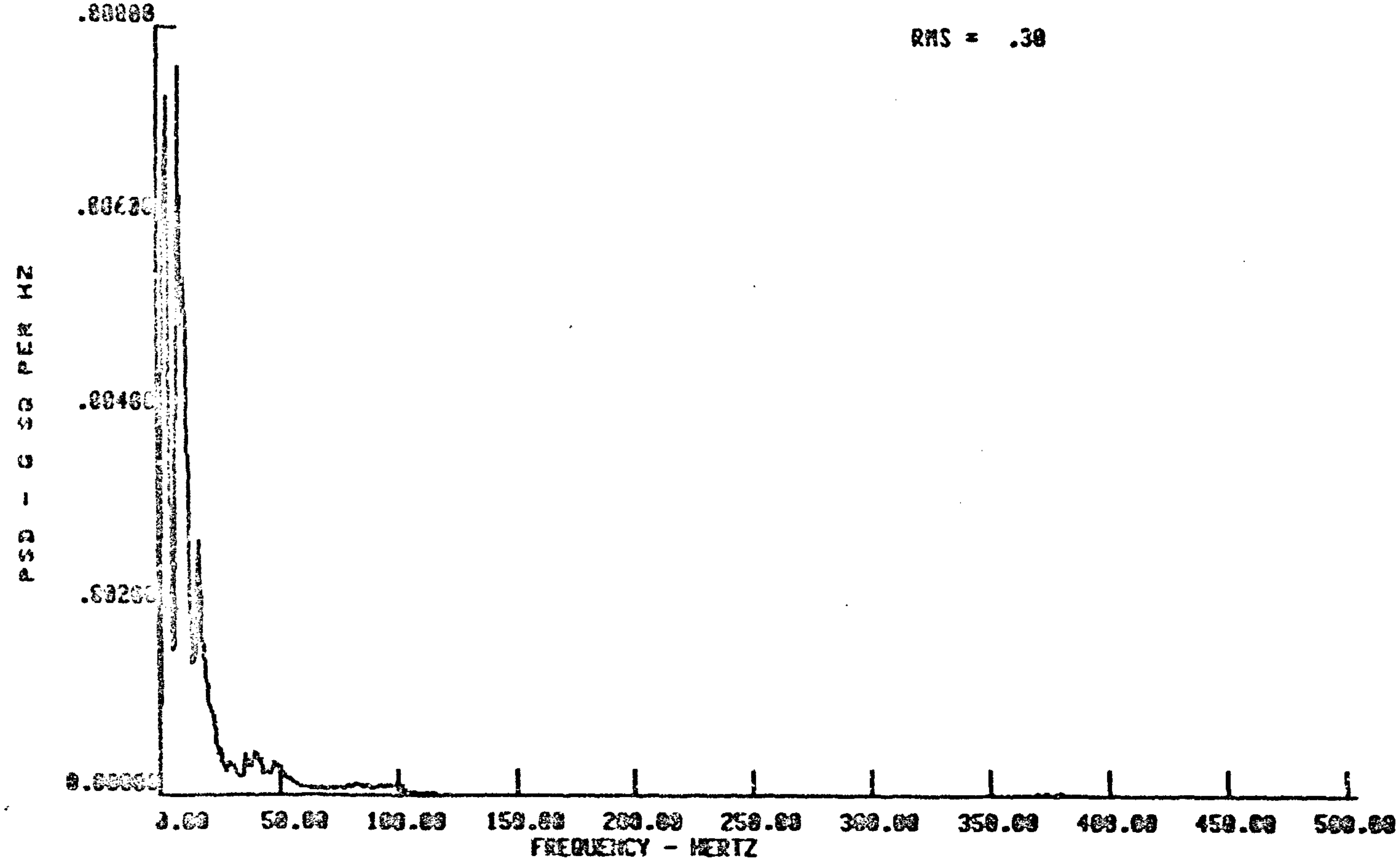


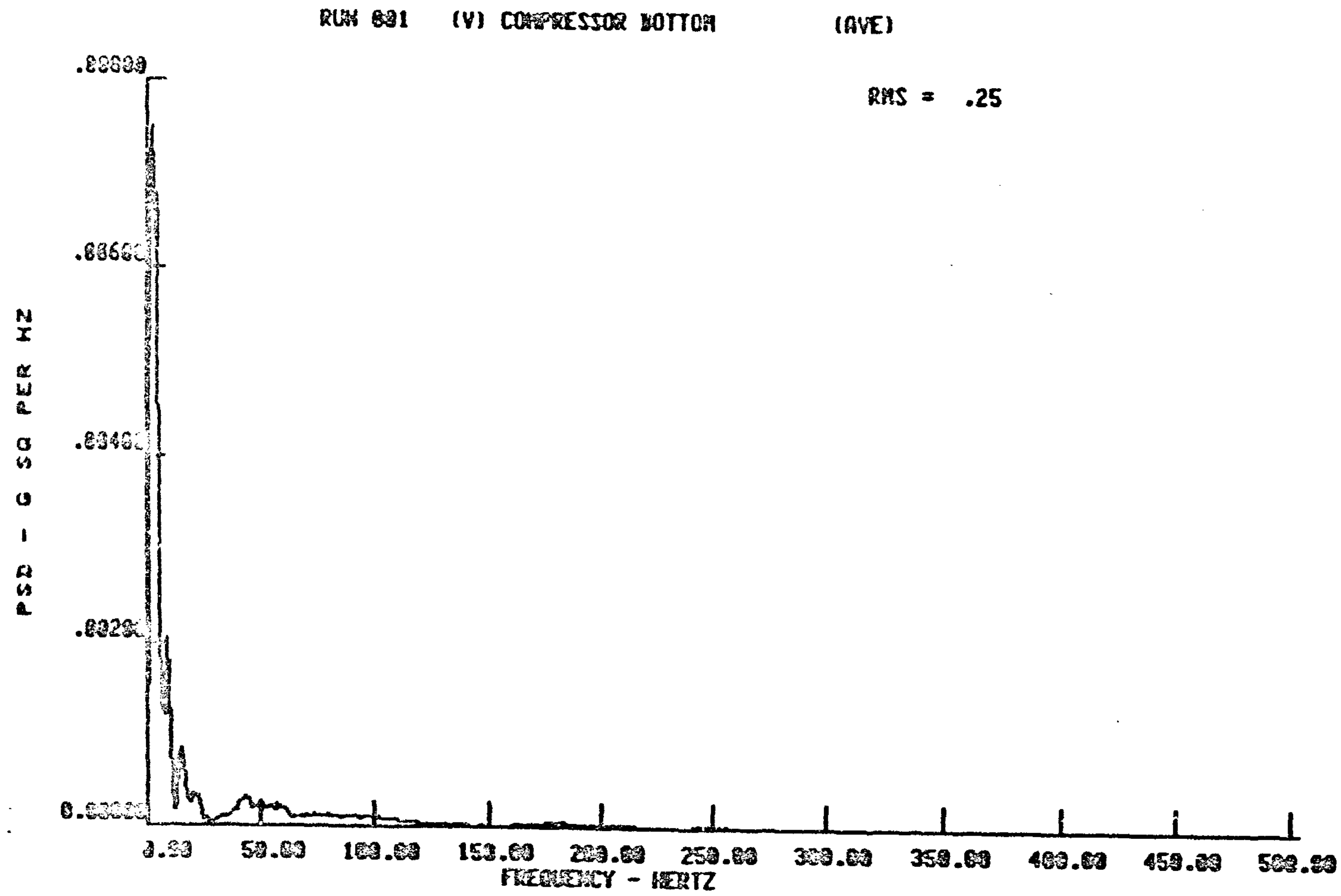
RUN 002 (V) AIR COND MOUNTING BRACKET (AVE)

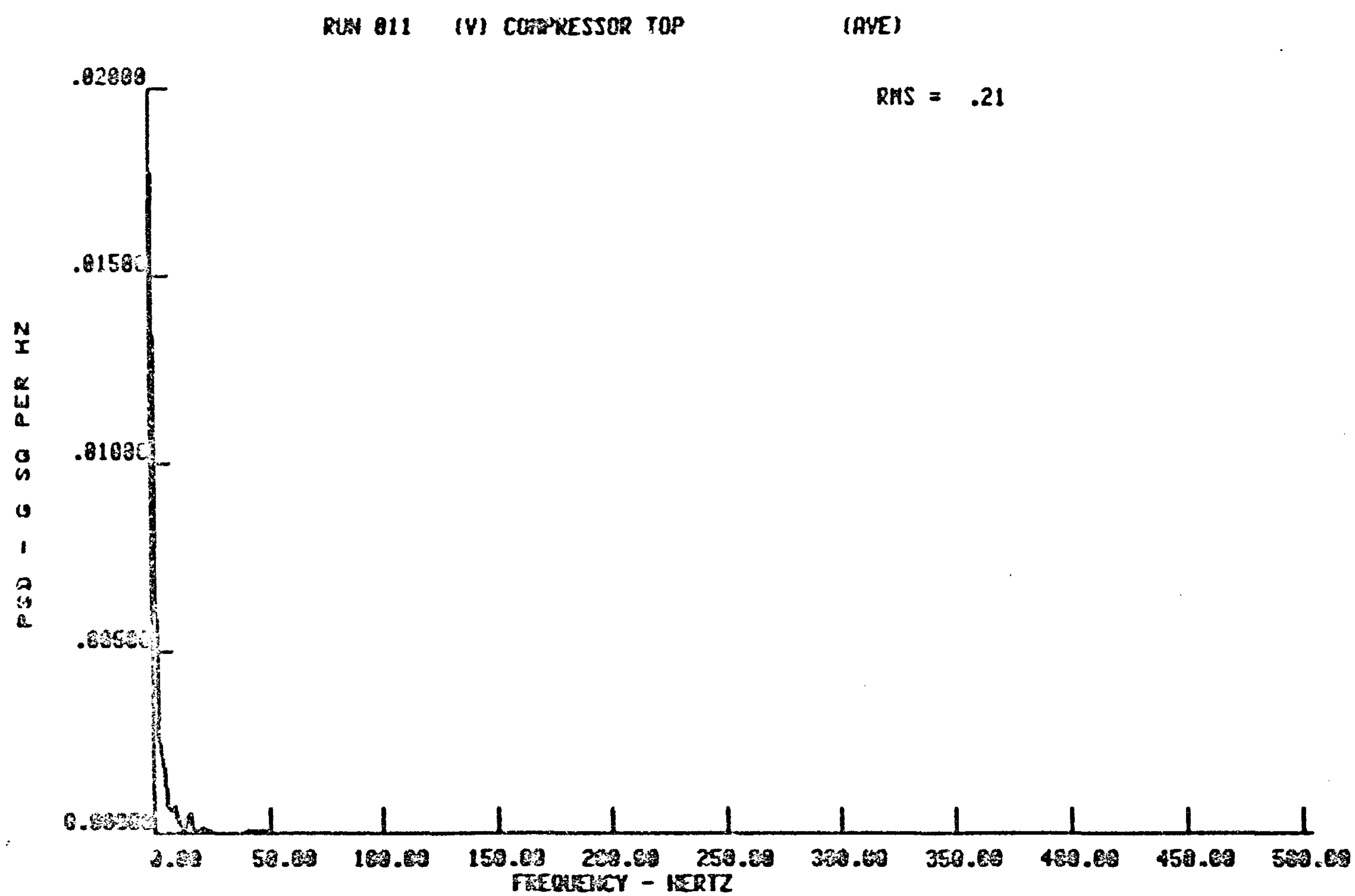


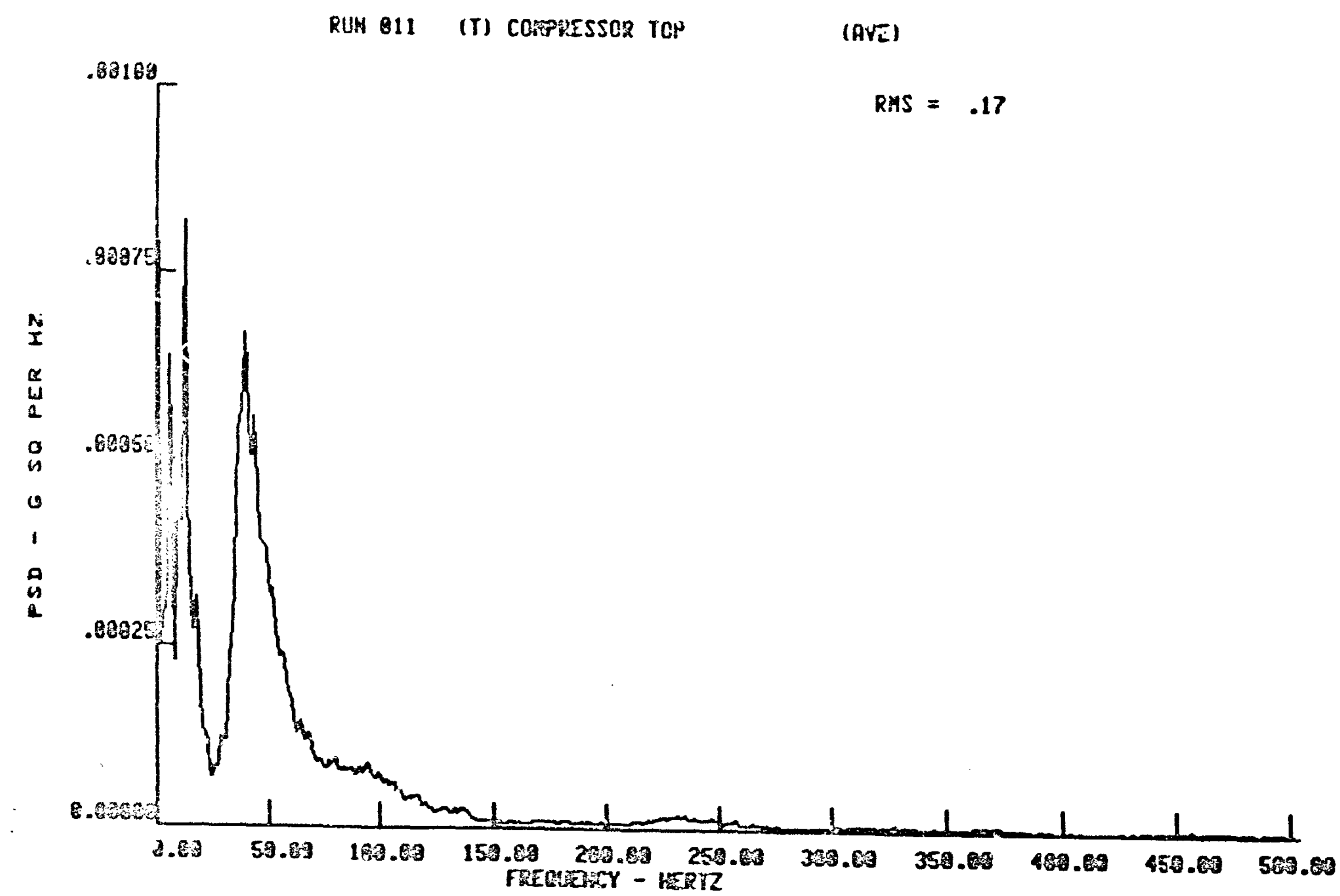

RUN 002 (T) AIR COND MOUNTING BRACKET (AVE)
RMS = .32
PSD - G SQ PER HZ
.04000
.03000
.02000
.01000
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

RUN 602 (L) AIR COND MOUNTING BRACKET (AVE)

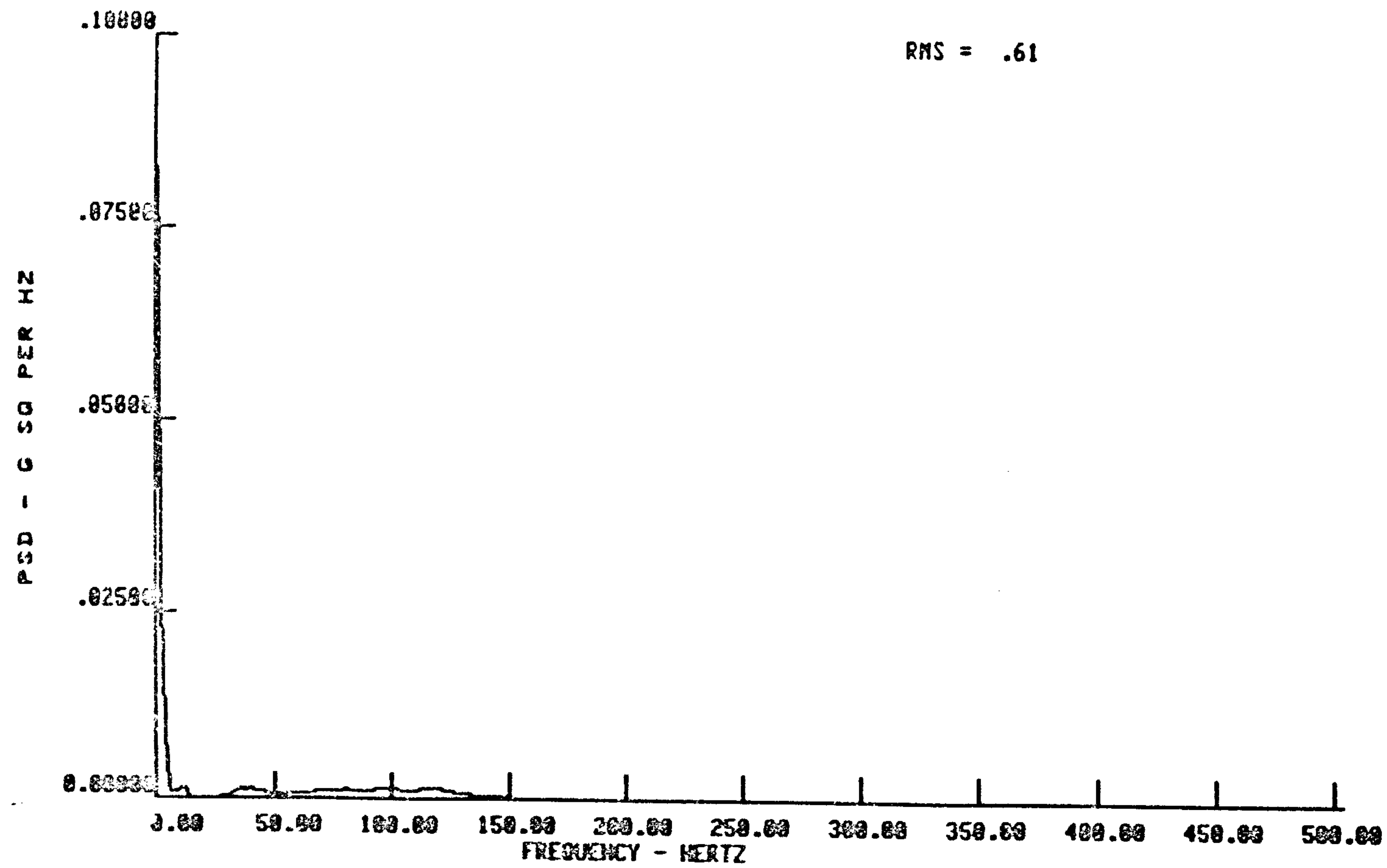



RUN 001 (V) COMPRESSOR BOTTOM (AVE)
RMS = .25
PSD - G SQ PER HZ
FREQUENCY - HERTZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00

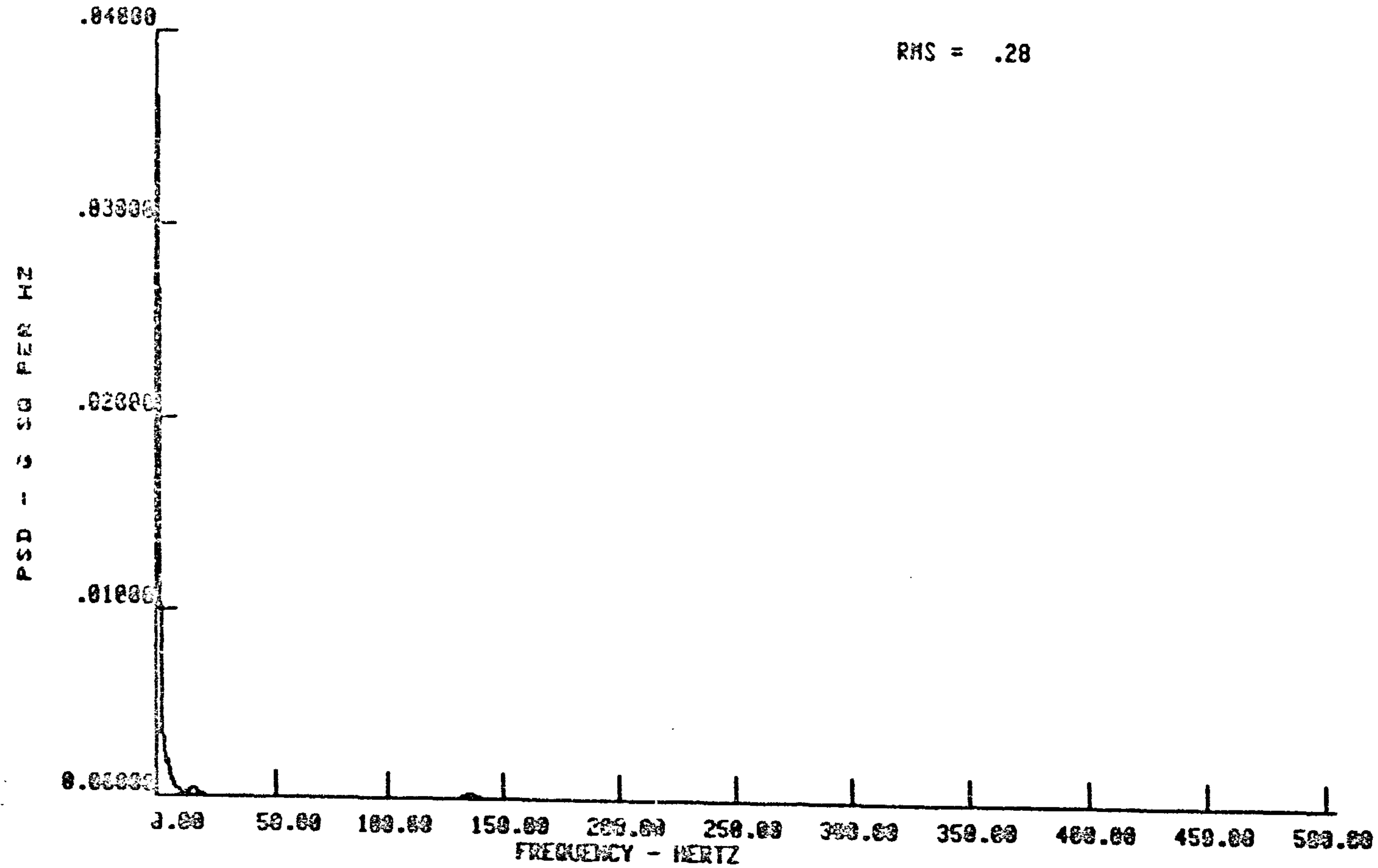

RUN 011 (V) COMPRESSOR TOP (AVE)
RMS = .21
.02000
.01500
.01000
.00500
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ


RUN 011 (T) COMPRESSOR TOP (AVE)
RMS = .17
.00100
.00075
.00050
.00025
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

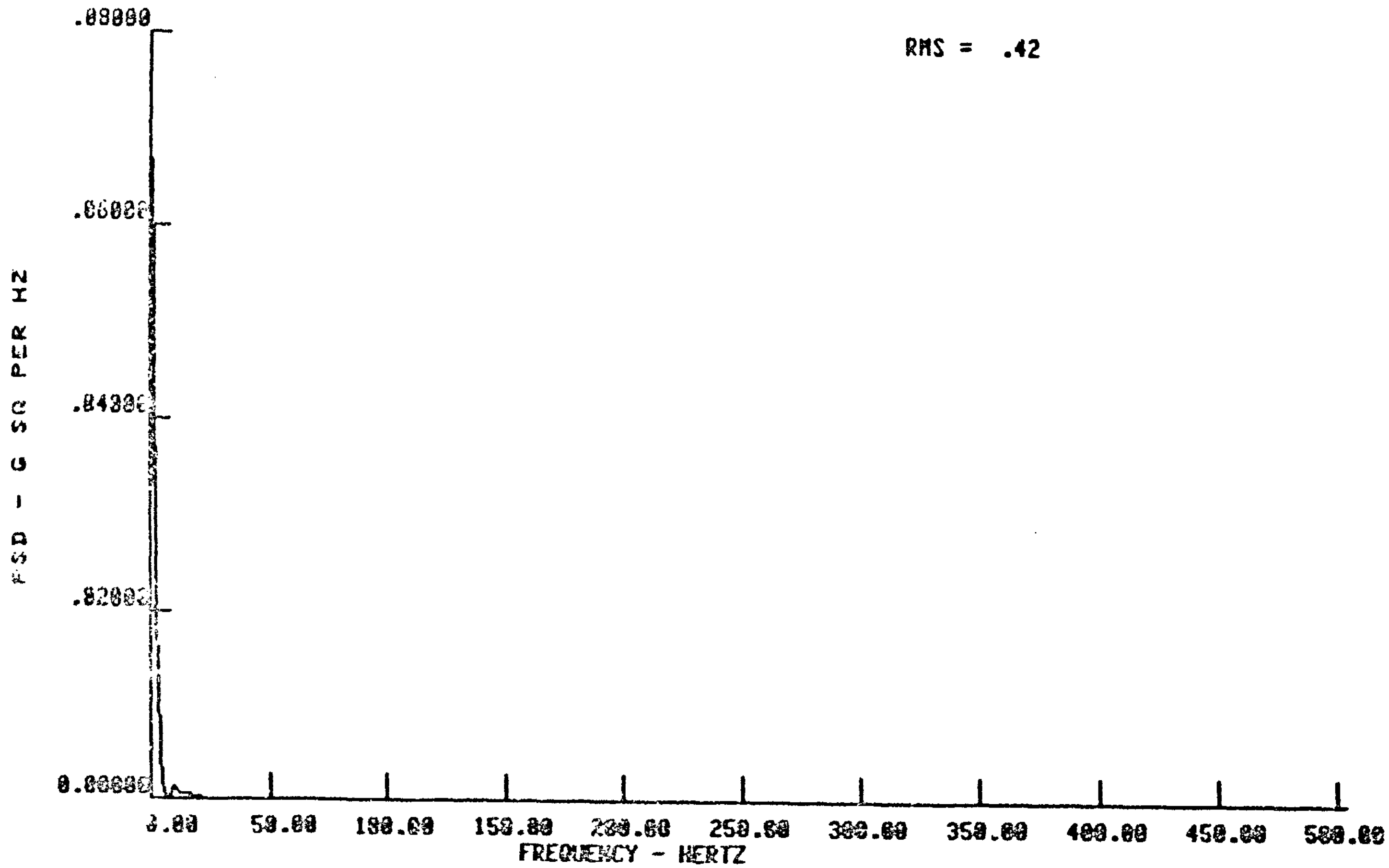
RUN 011 (L) COMPRESSOR TOP (AVE)

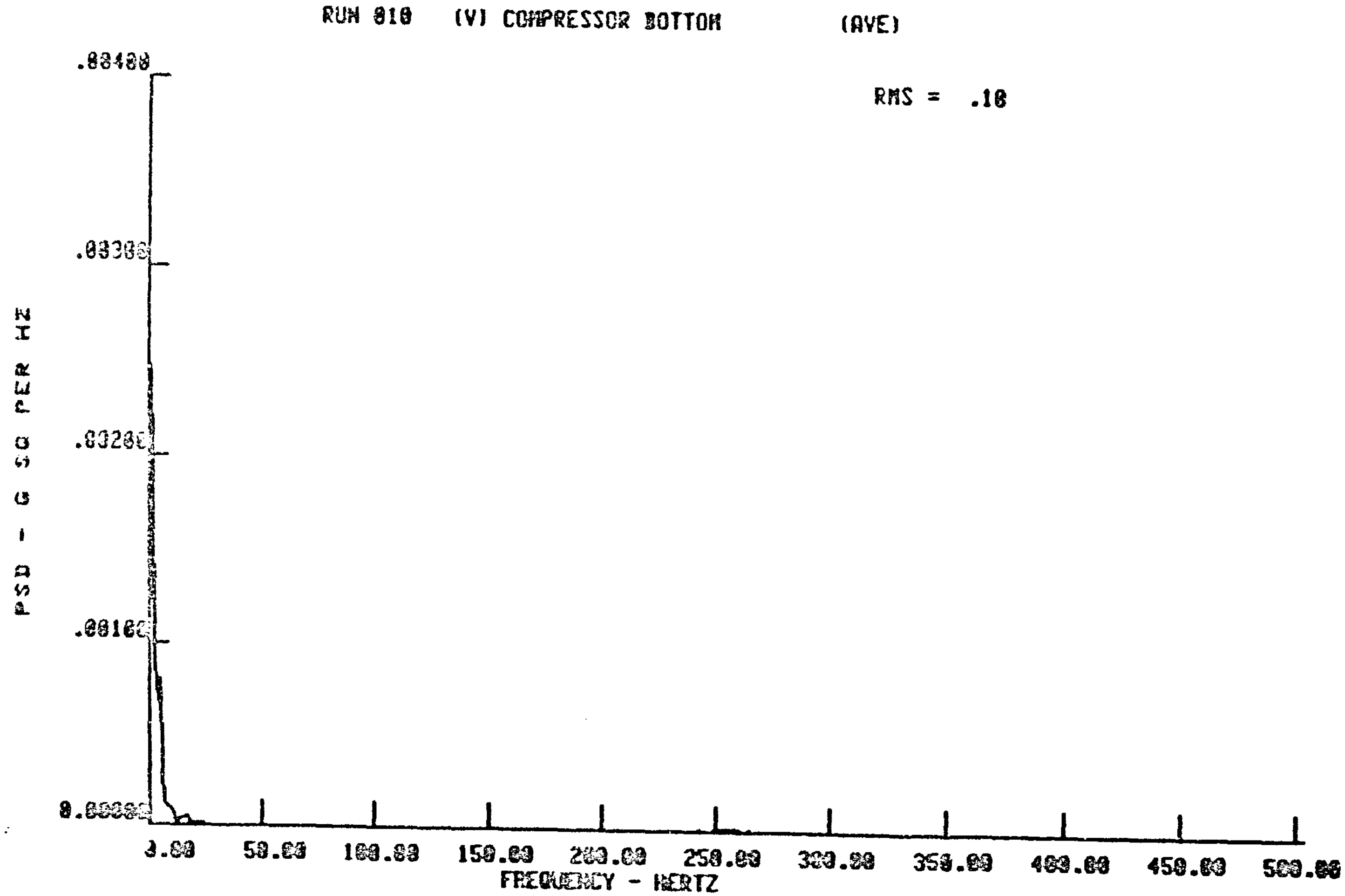


RUN 011 (V) AIR COMB MOUNTING BRACKET (AVE)

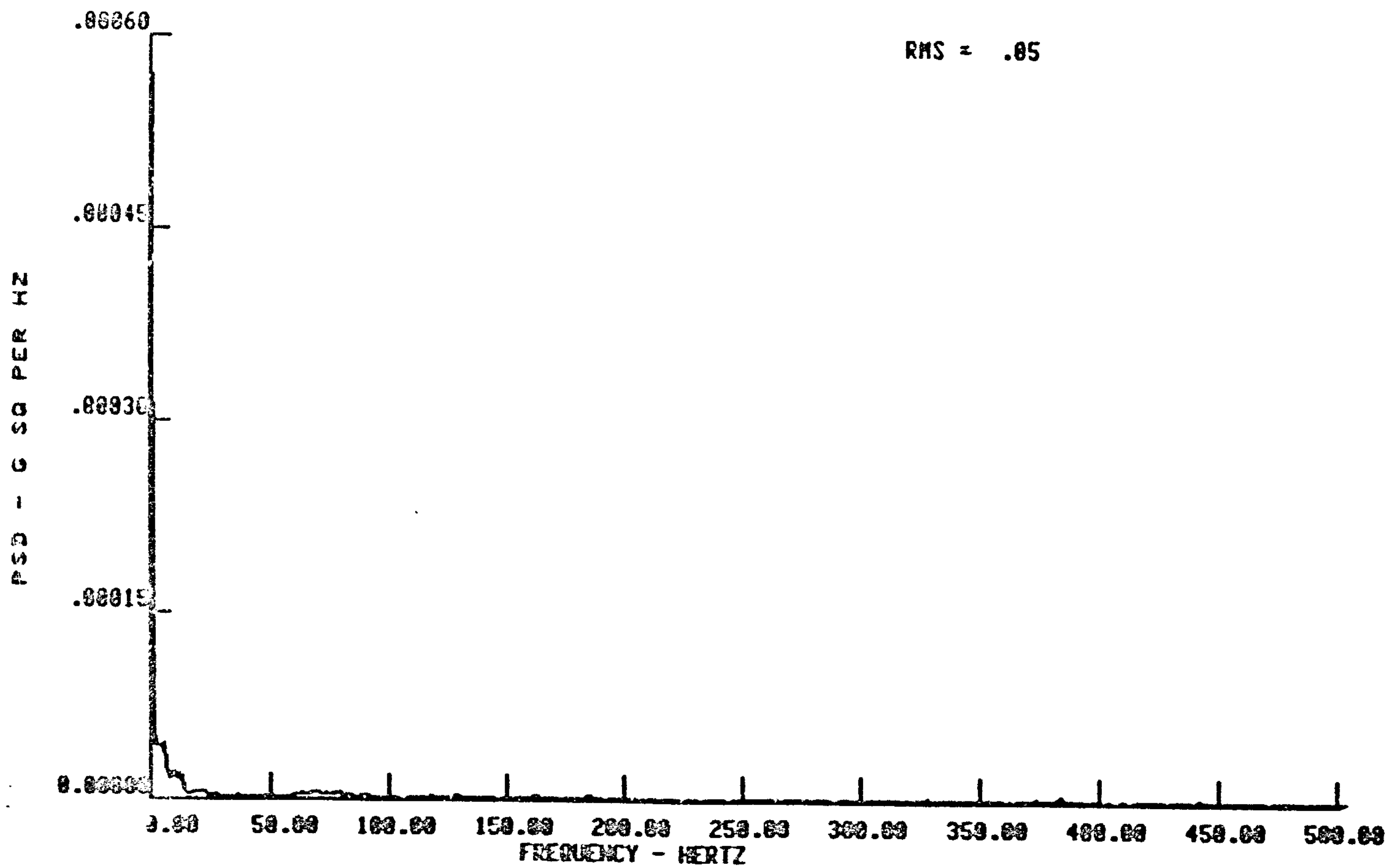


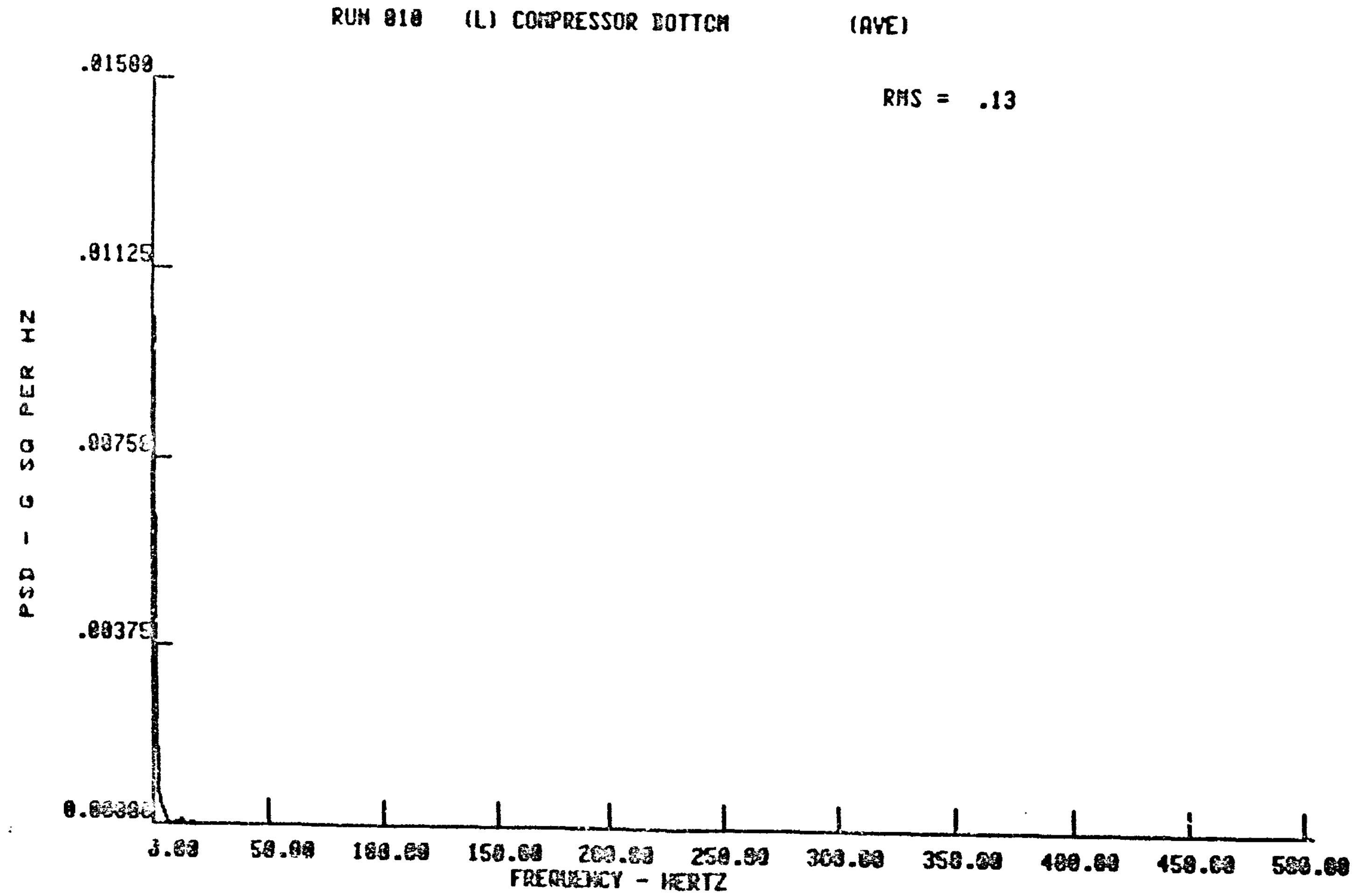
RUN 011 (L) AIR COND MOUNTING BRACKET (AVE)

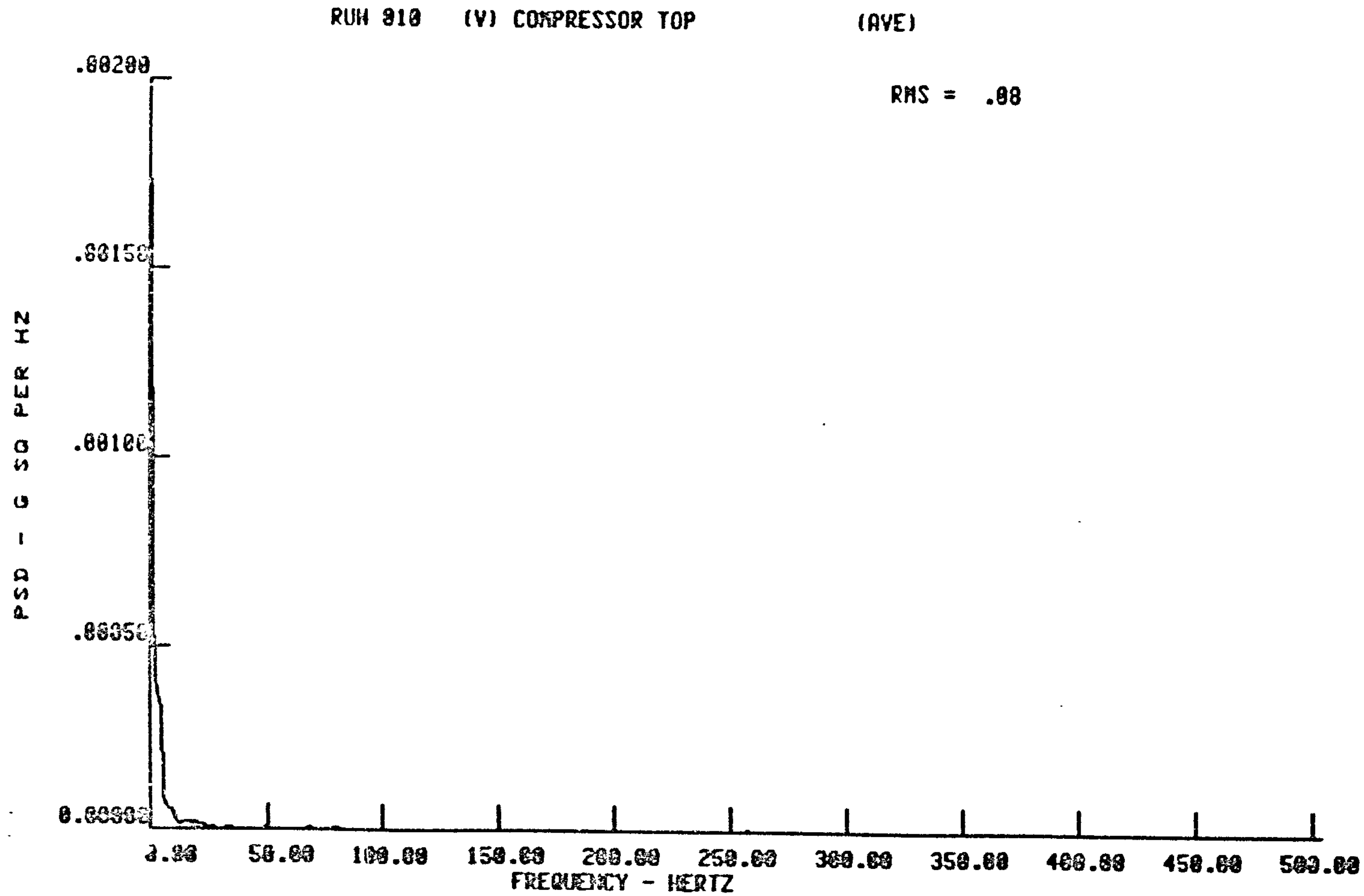



RUN 010 (V) COMPRESSOR BOTTOM (AVE)
RMS = .10
PSD - G SQ PER HZ
.00400
.00300
.00200
.00100
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

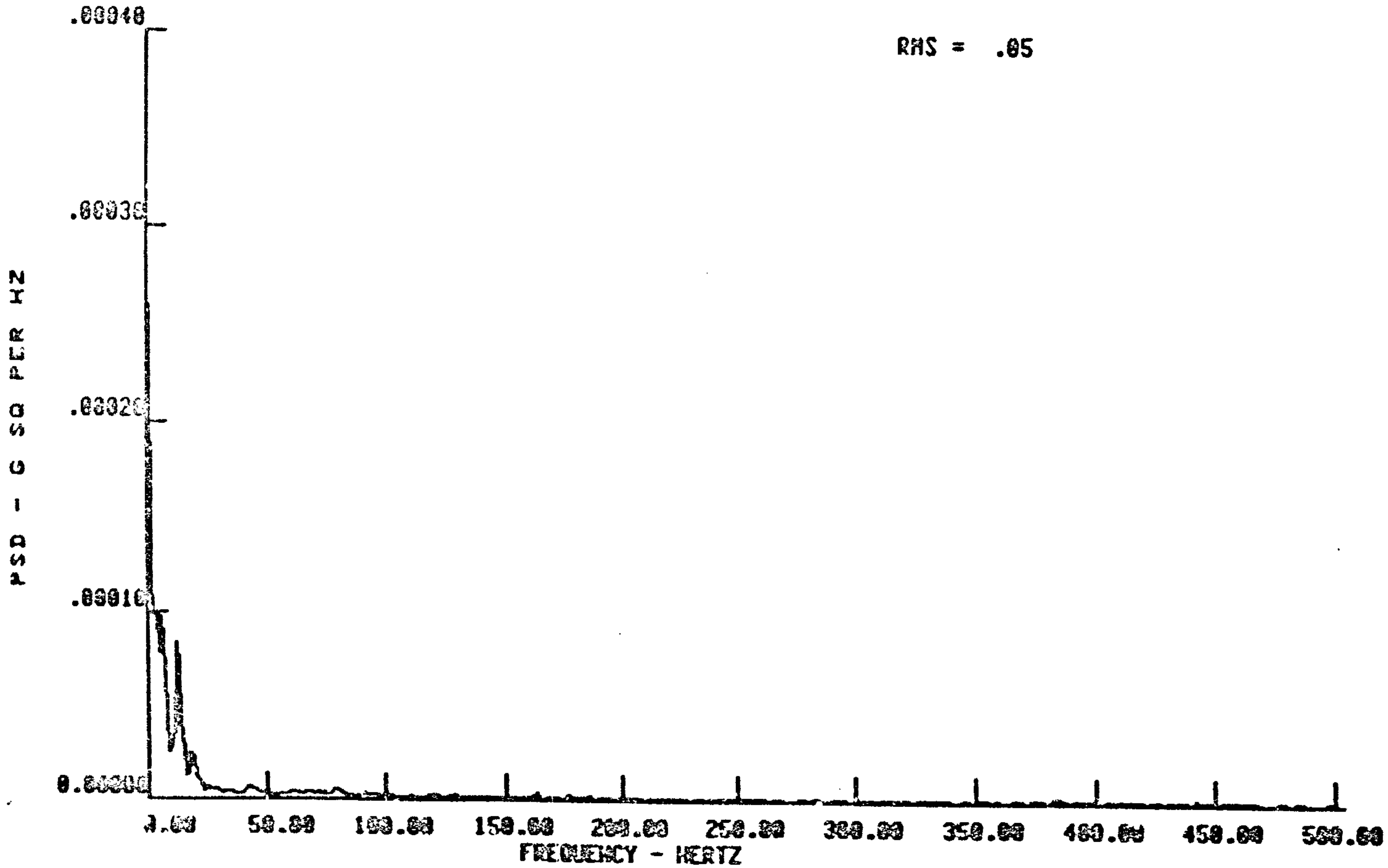
RUN 010 (T) COMPRESSOR BOTTOM (AVE)



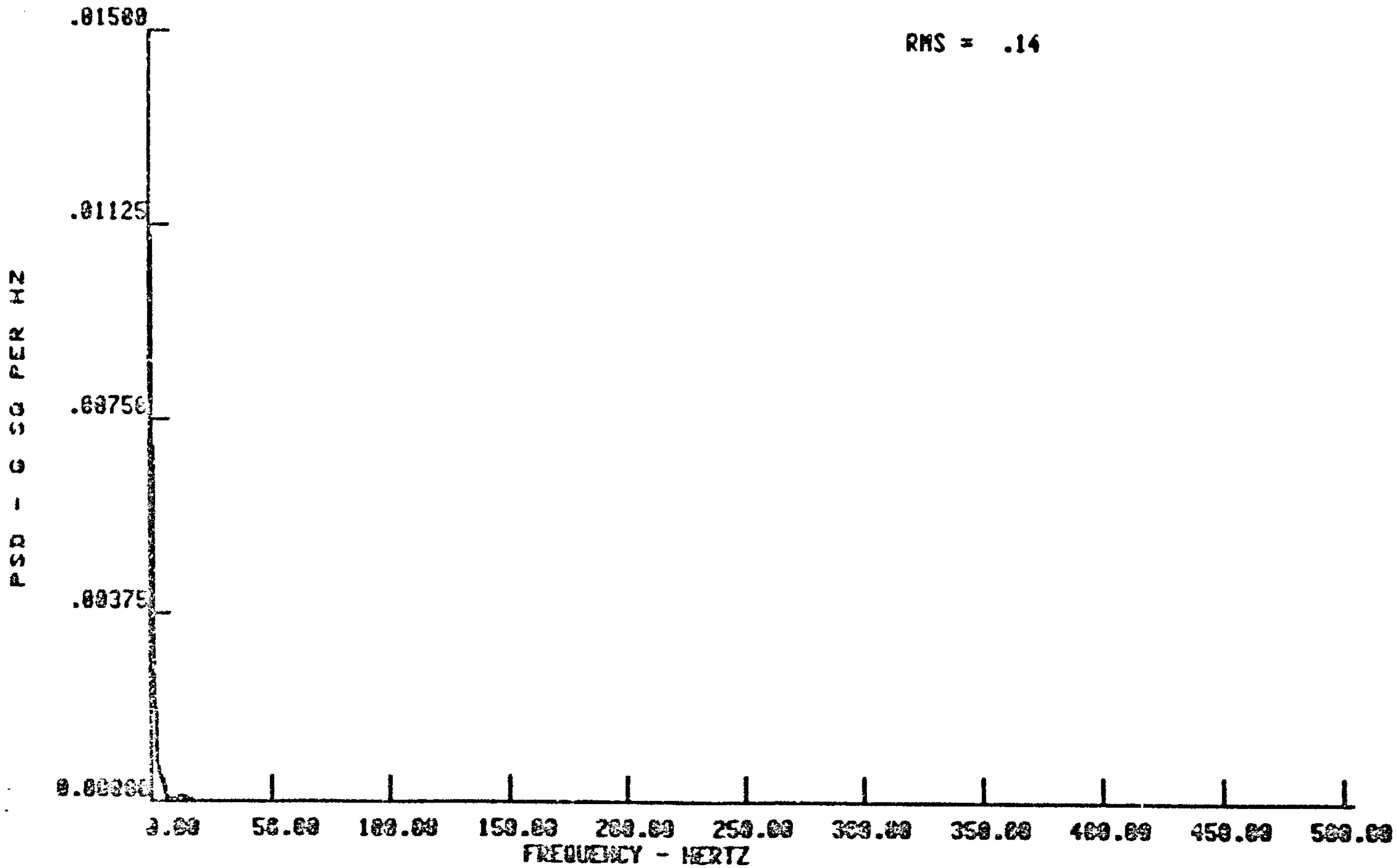

RUN 010 (L) COMPRESSOR BOTTOM (AVE)
RMS = .13
.01500
.01125
.00750
.00375
0.00000
PSD - G SQ PER HZ
3.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ


RUN 010 (V) COMPRESSOR TOP (AVE)
RMS = .08
PSD - G SQ PER HZ
.00200
.00150
.00100
.00050
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

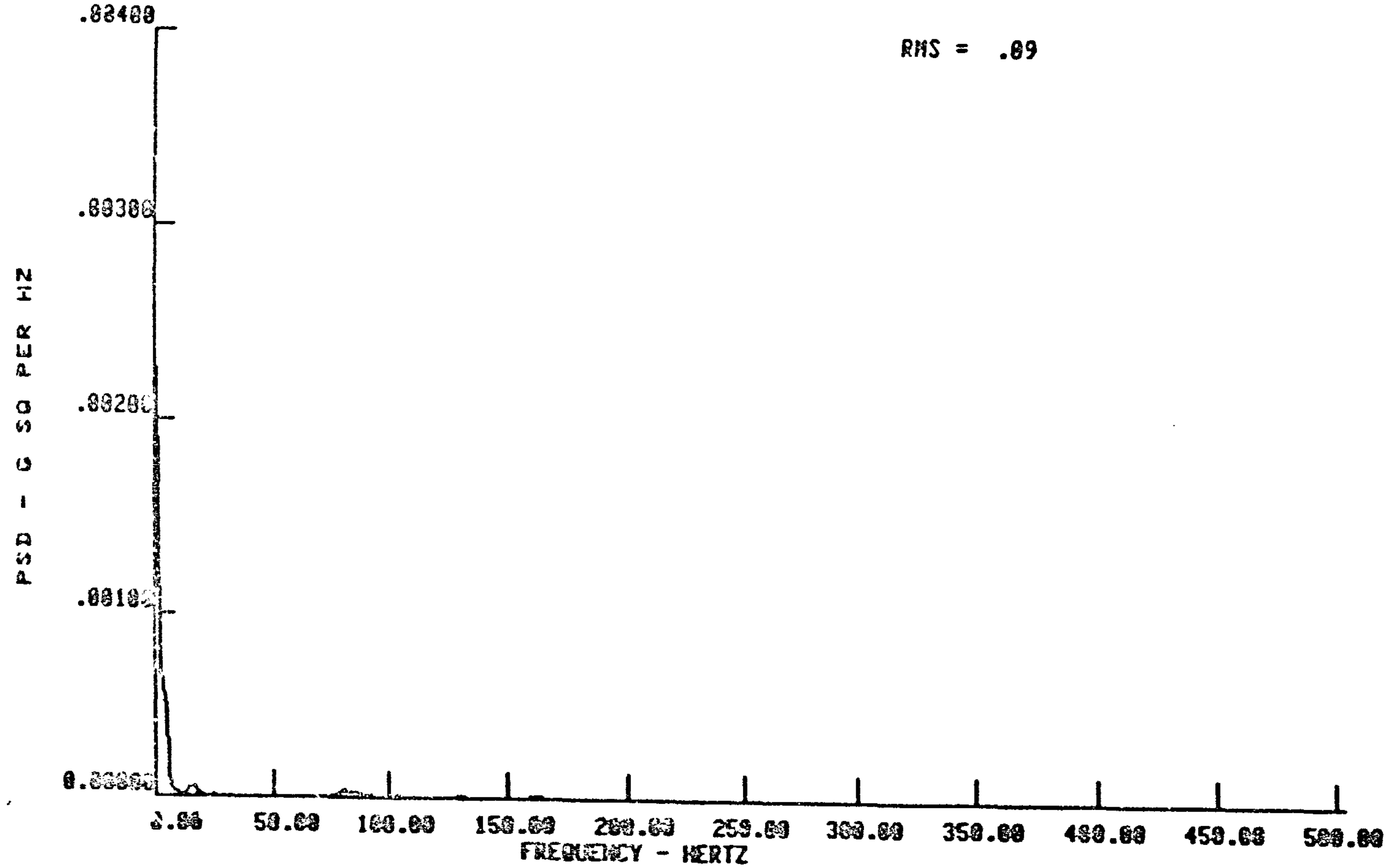
RUN 010 (T) COMPRESSOR TOP (AVE)



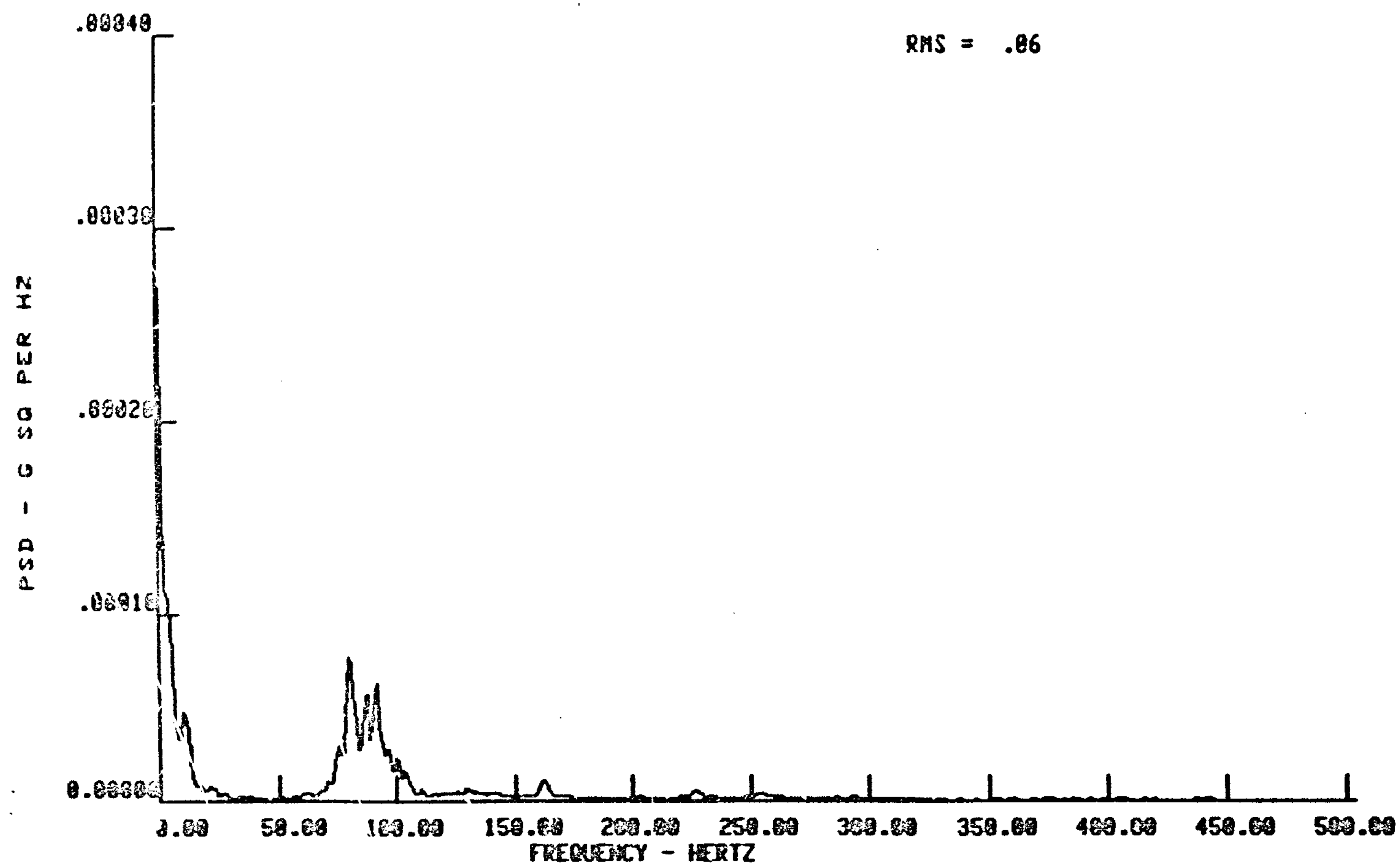
RUN 010 (L) COMPRESSOR TOP (AVE)



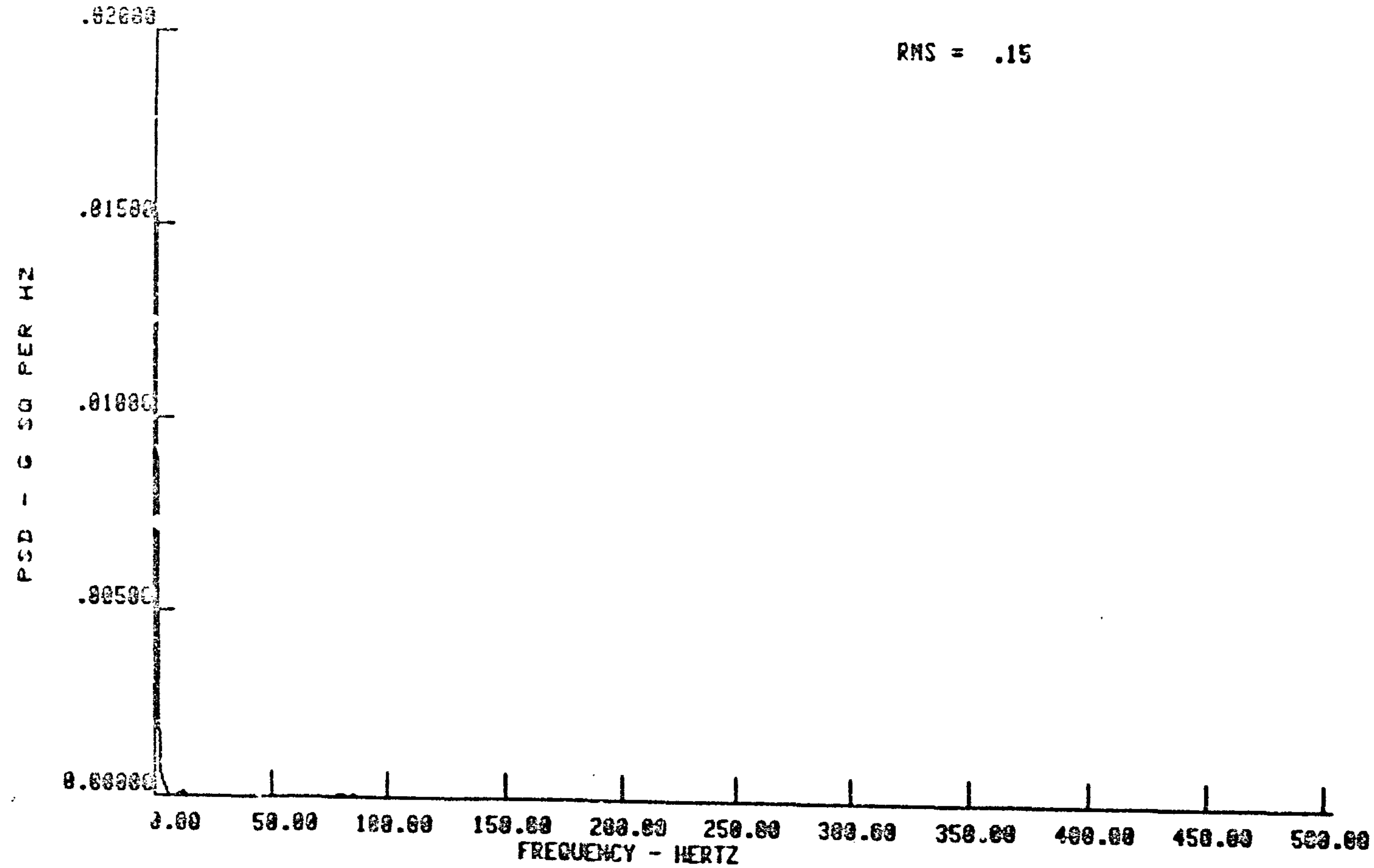
RUN 010 (V) AIR COND MOUNTING BRACKET (AVE)

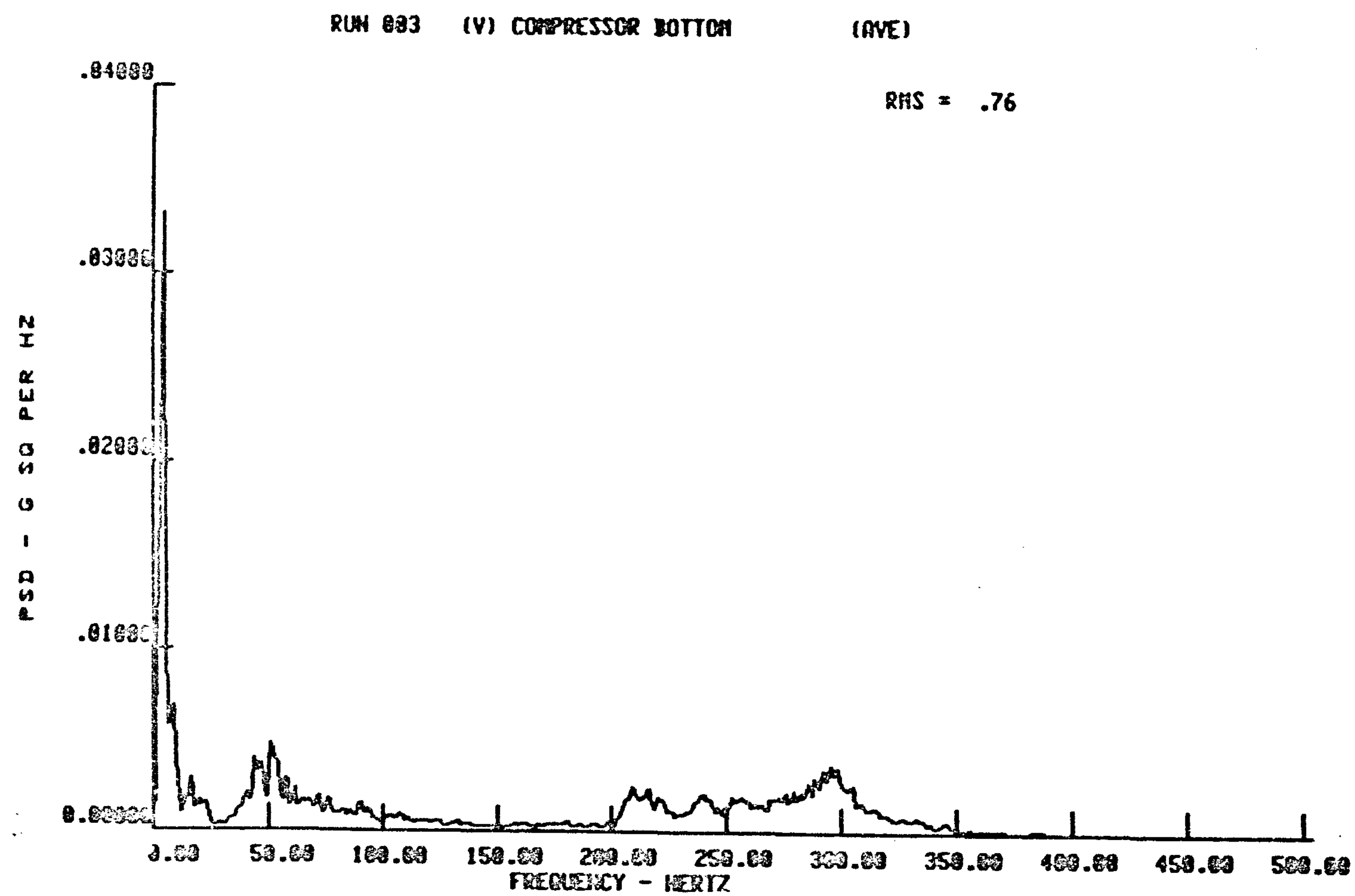


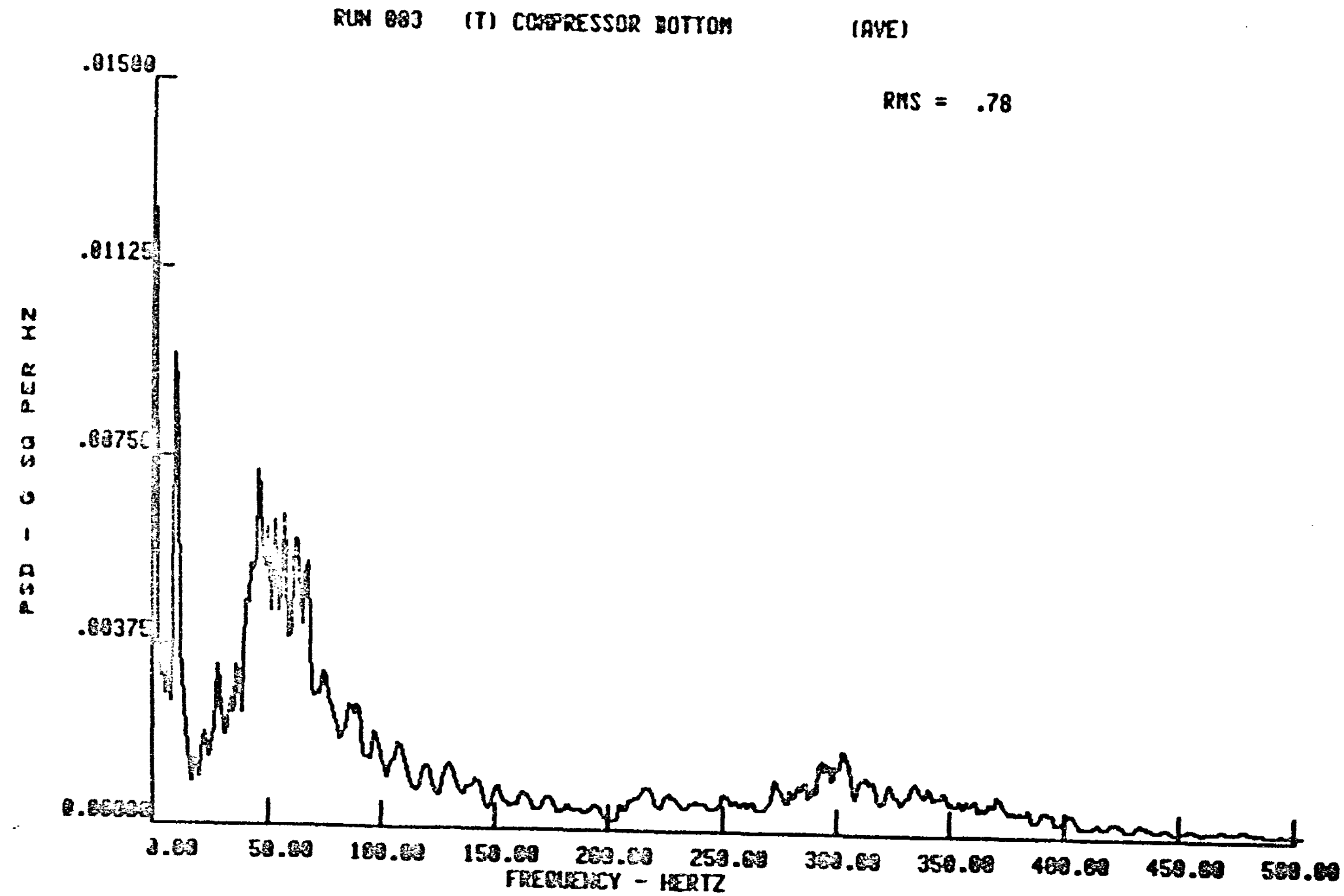
RUN 010 (T) AIR COND MOUNTING BRACKET (AVE)

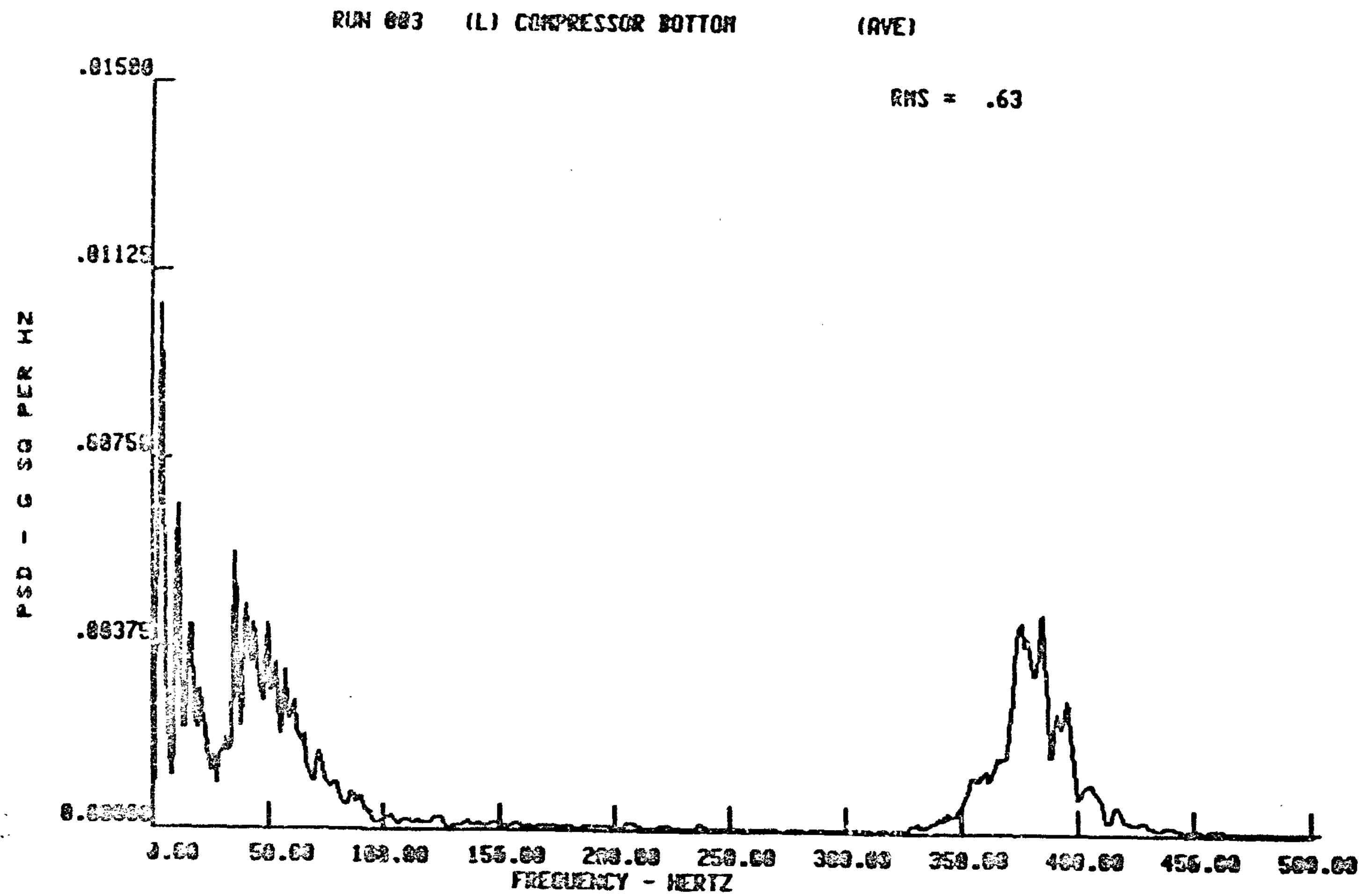


RUN 010 (L) AIR COND MOUNTING BRACKET (AVE)

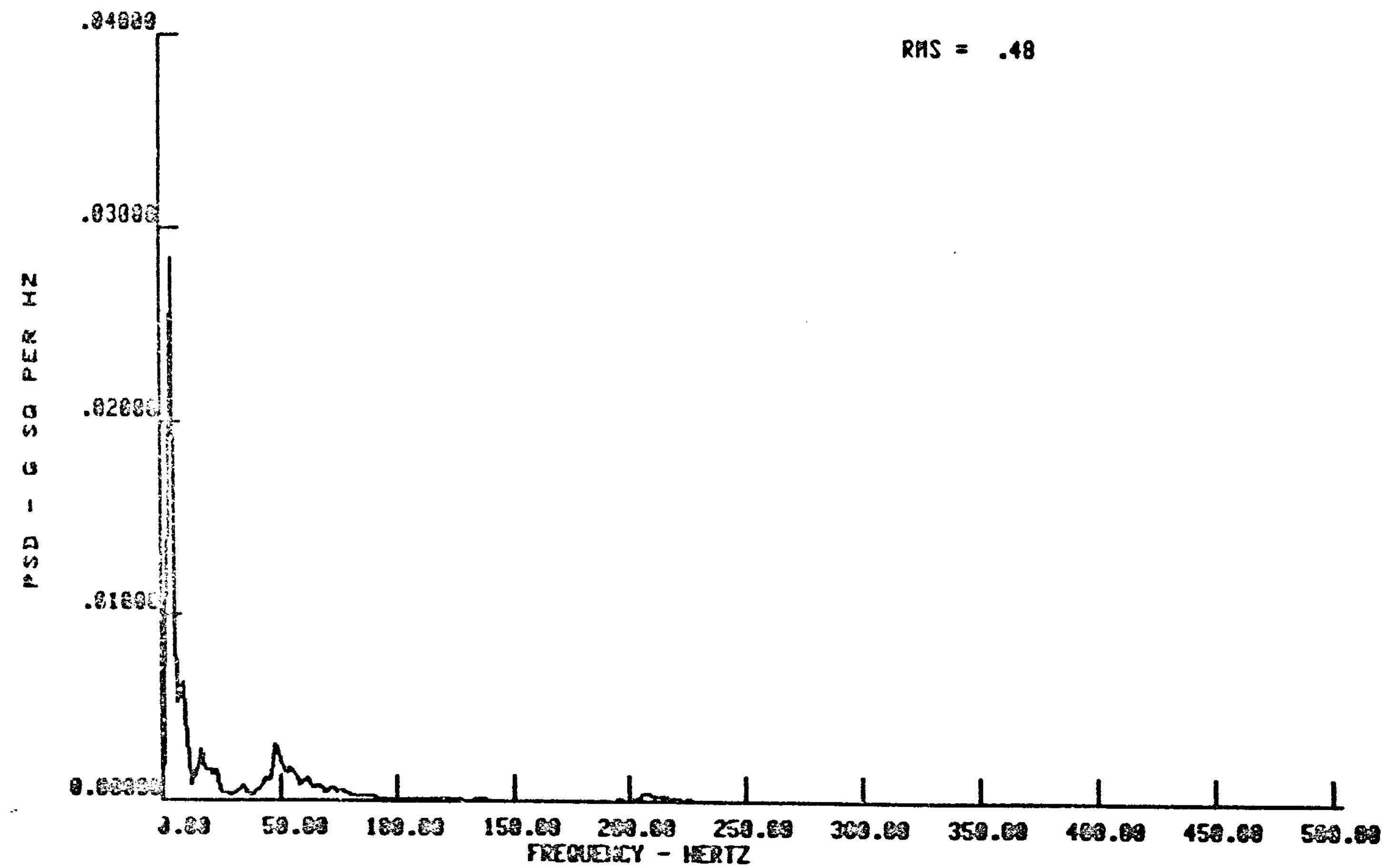


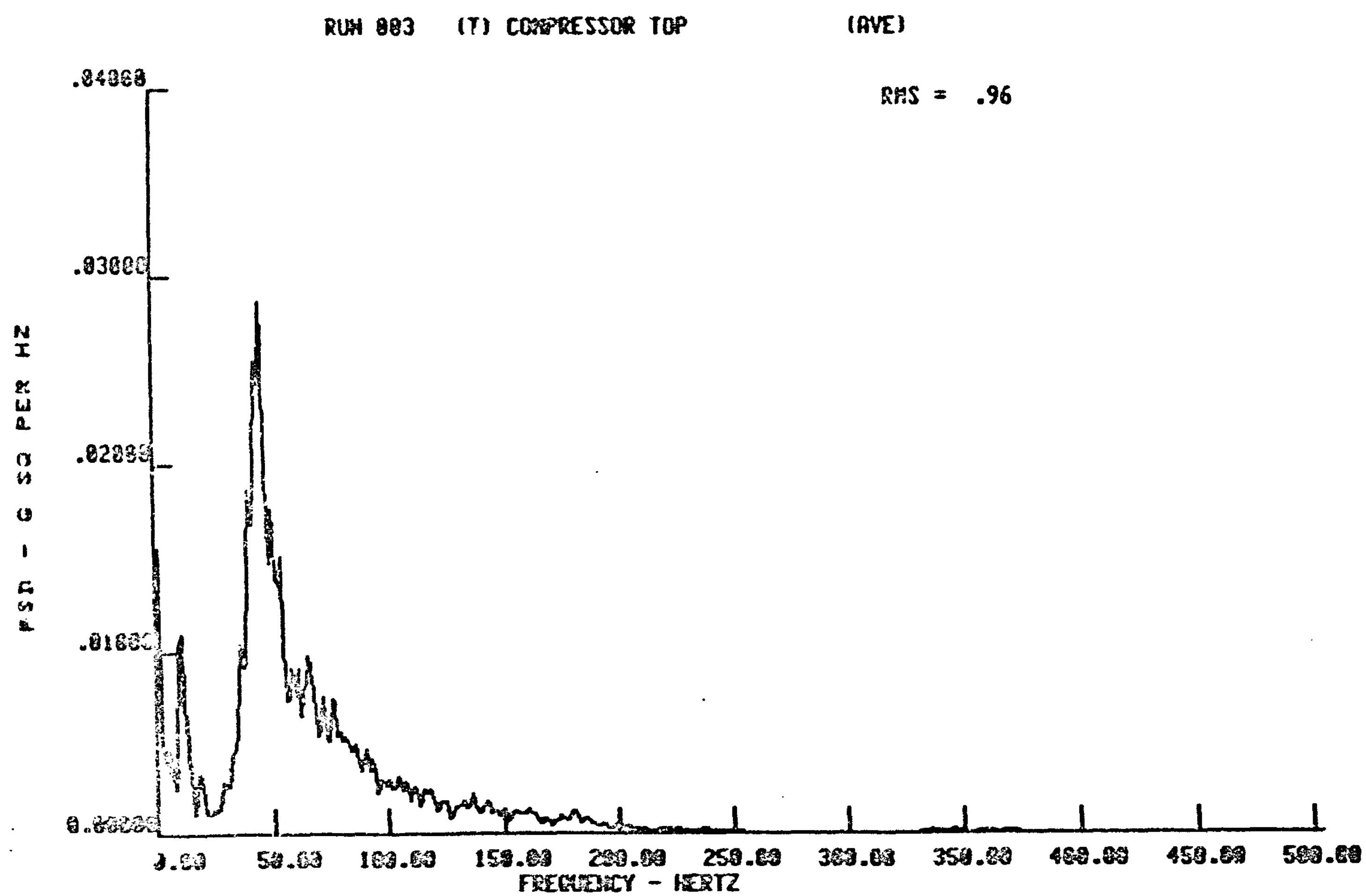

RUN 003 (V) COMPRESSOR BOTTOM (AVE)
RMS = .76
.04000
.03000
.02000
.01000
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

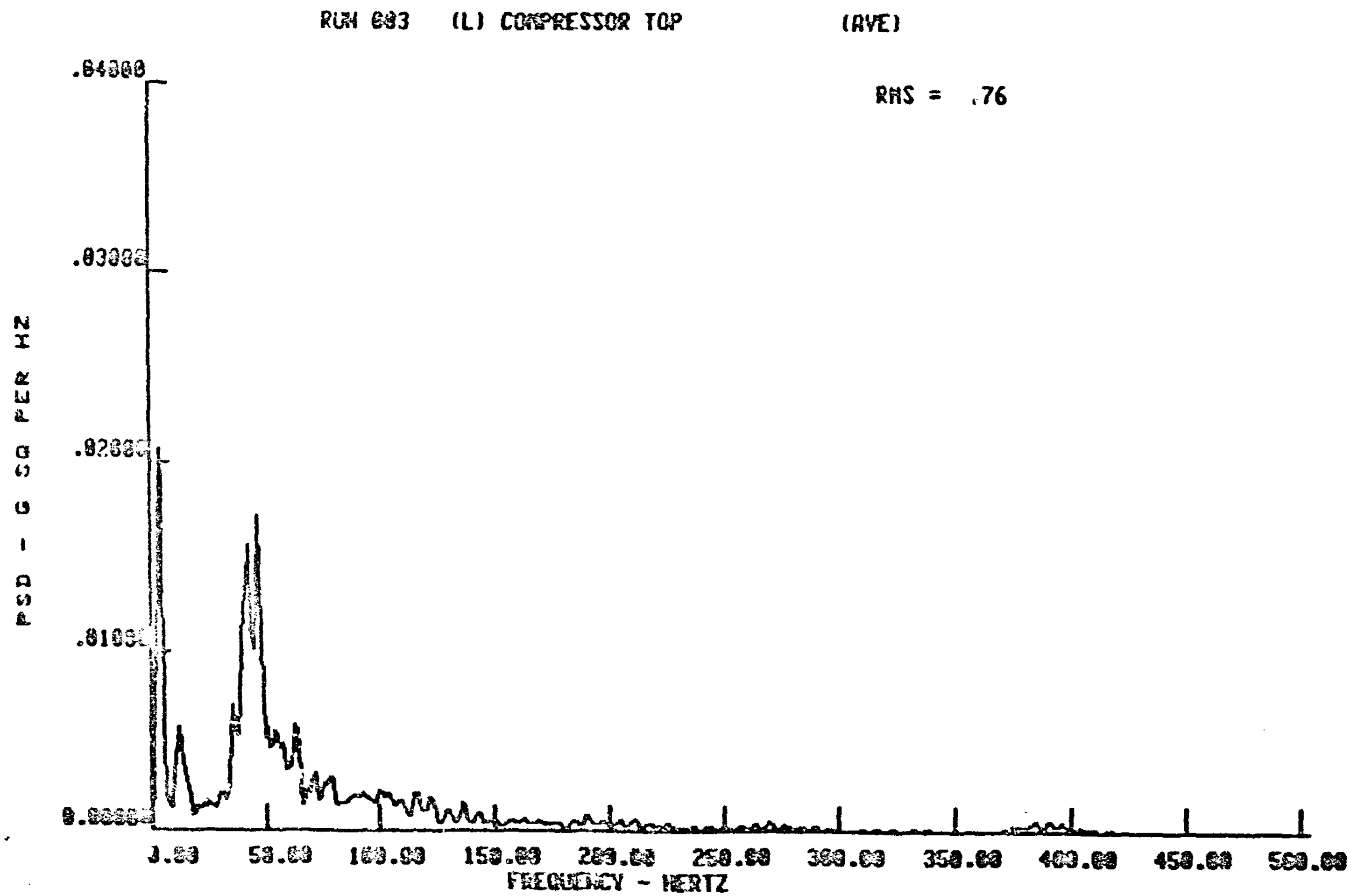

RUN 003 (T) COMPRESSOR BOTTOM (AVE)
RMS = .78
PSD - G SQ PER HZ
.01500
.01125
.00750
.00375
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ


RUN 003 (L) COMPRESSOR BOTTOM (AVE)
RMS = .63
.01500
.01125
.00750
.00375
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

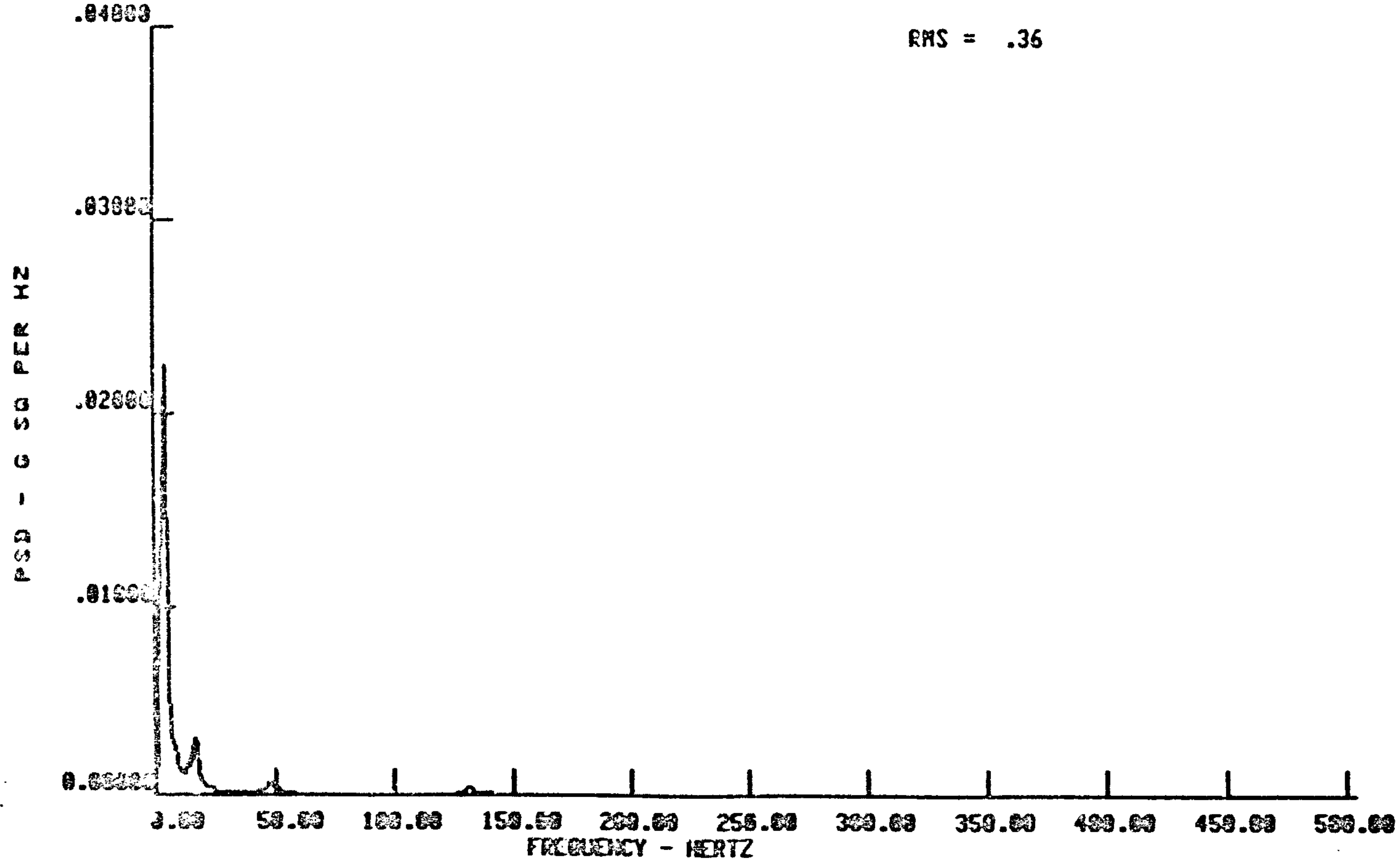
RUN 003 (V) COMPRESSOR TOP (AVE)



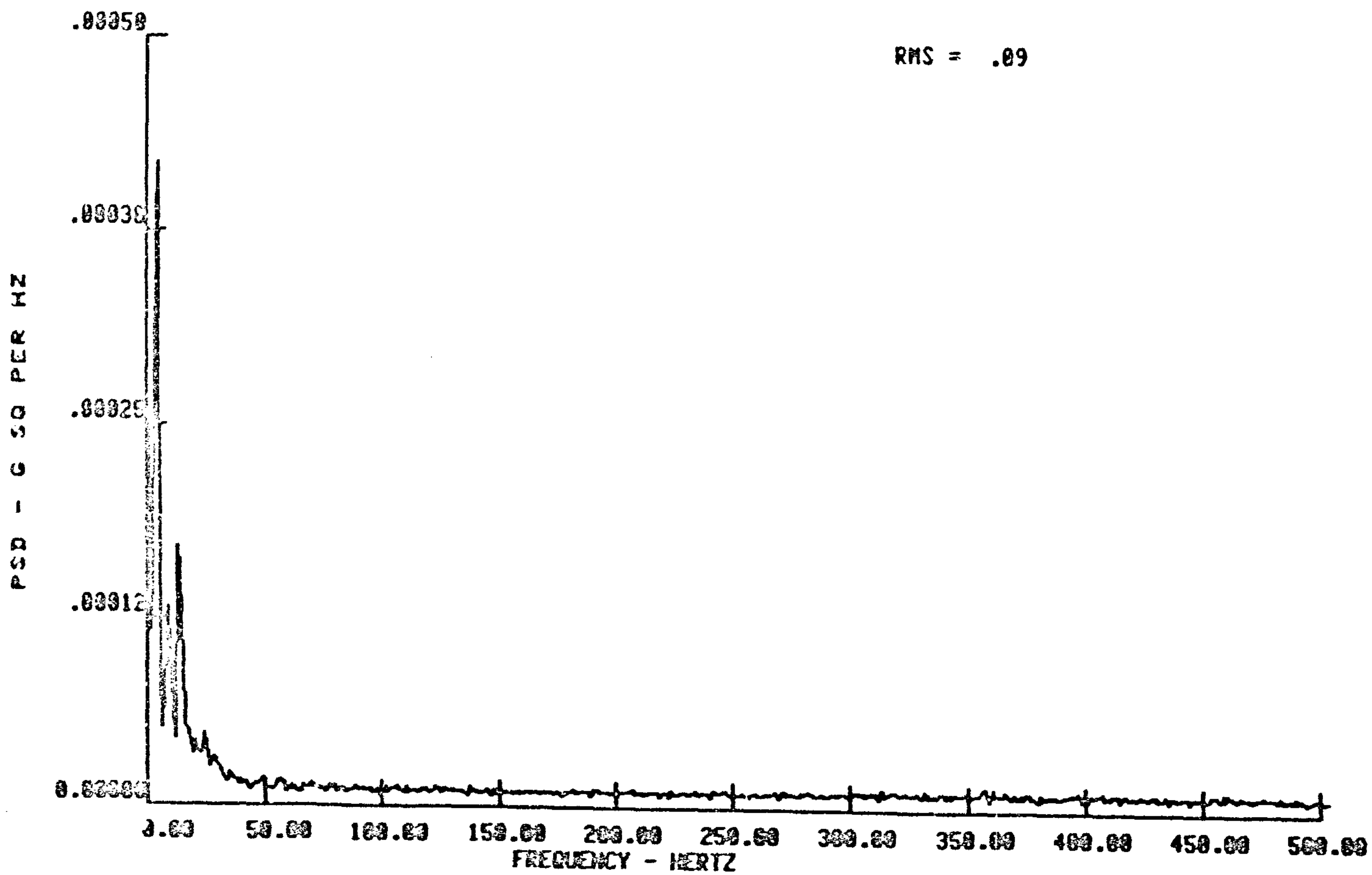

RUN 003 (T) COMPRESSOR TOP (AVE)
RMS = .96
.04000
.03000
.02000
.01000
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

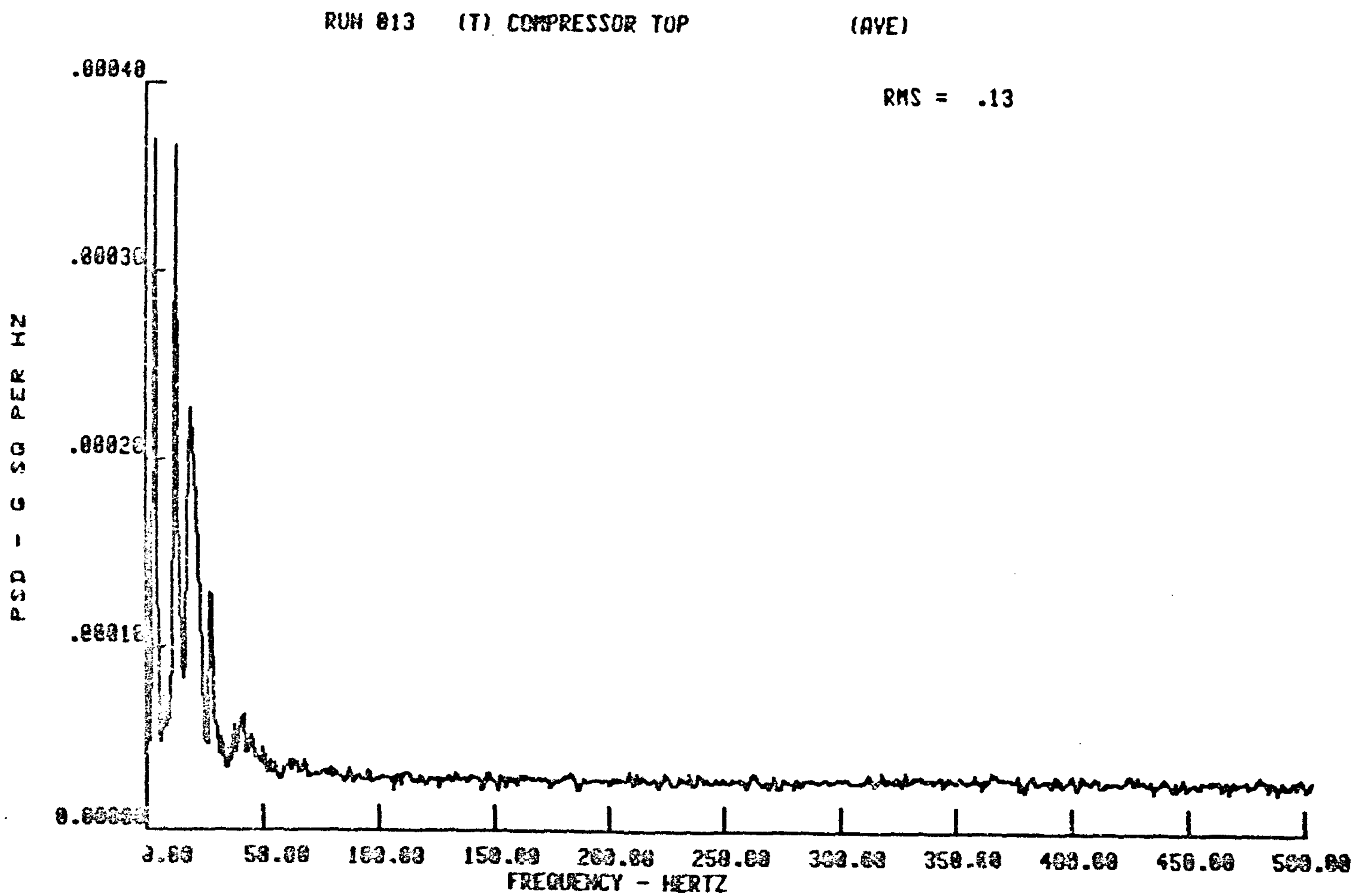

RUN 003 (L) COMPRESSOR TOP (AVE)
RMS = .76
.04000
.03000
.02000
.01000
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

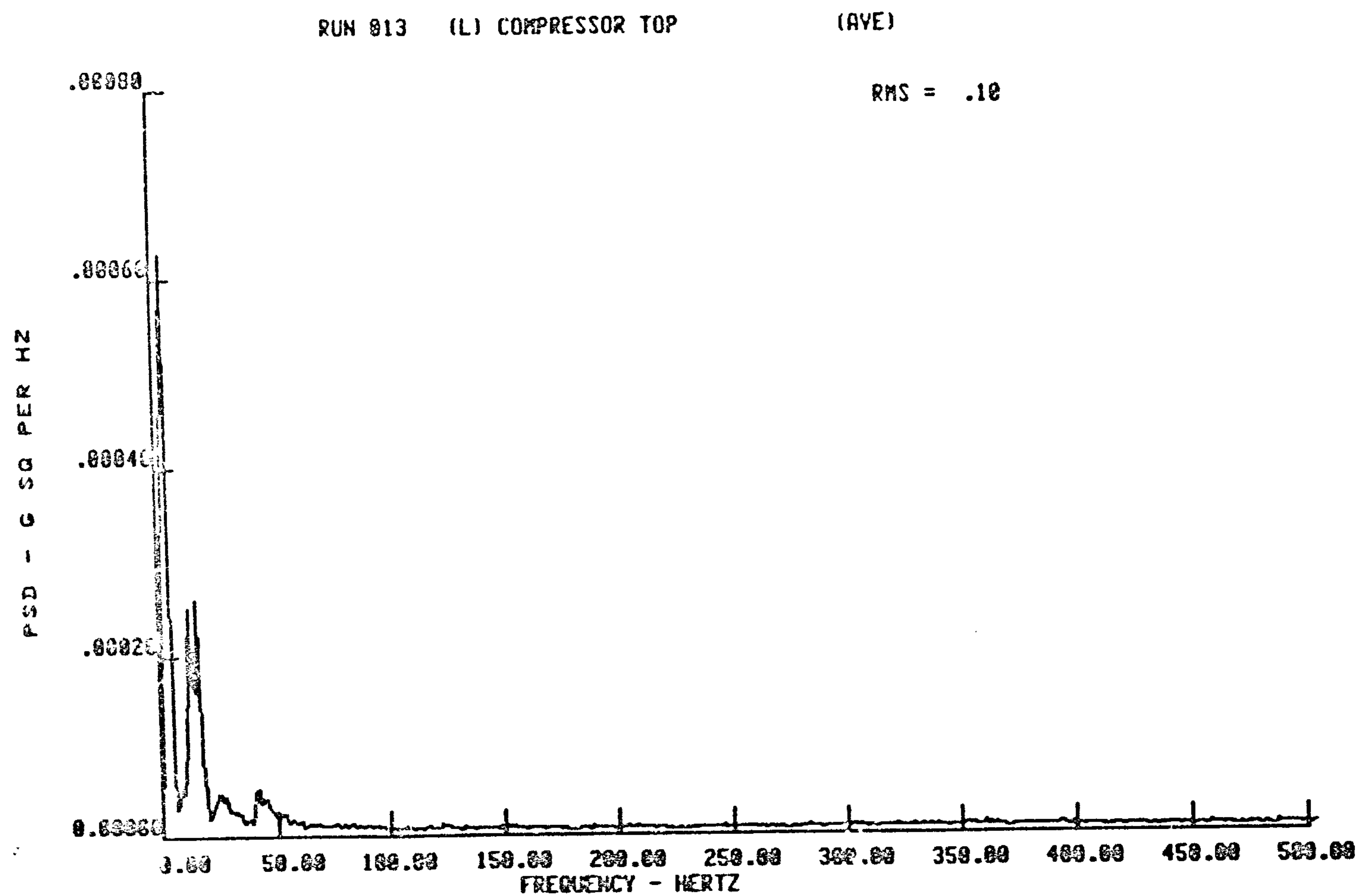
RUN 083 (V) AIR COND MOUNTING BRACKET (AVE)



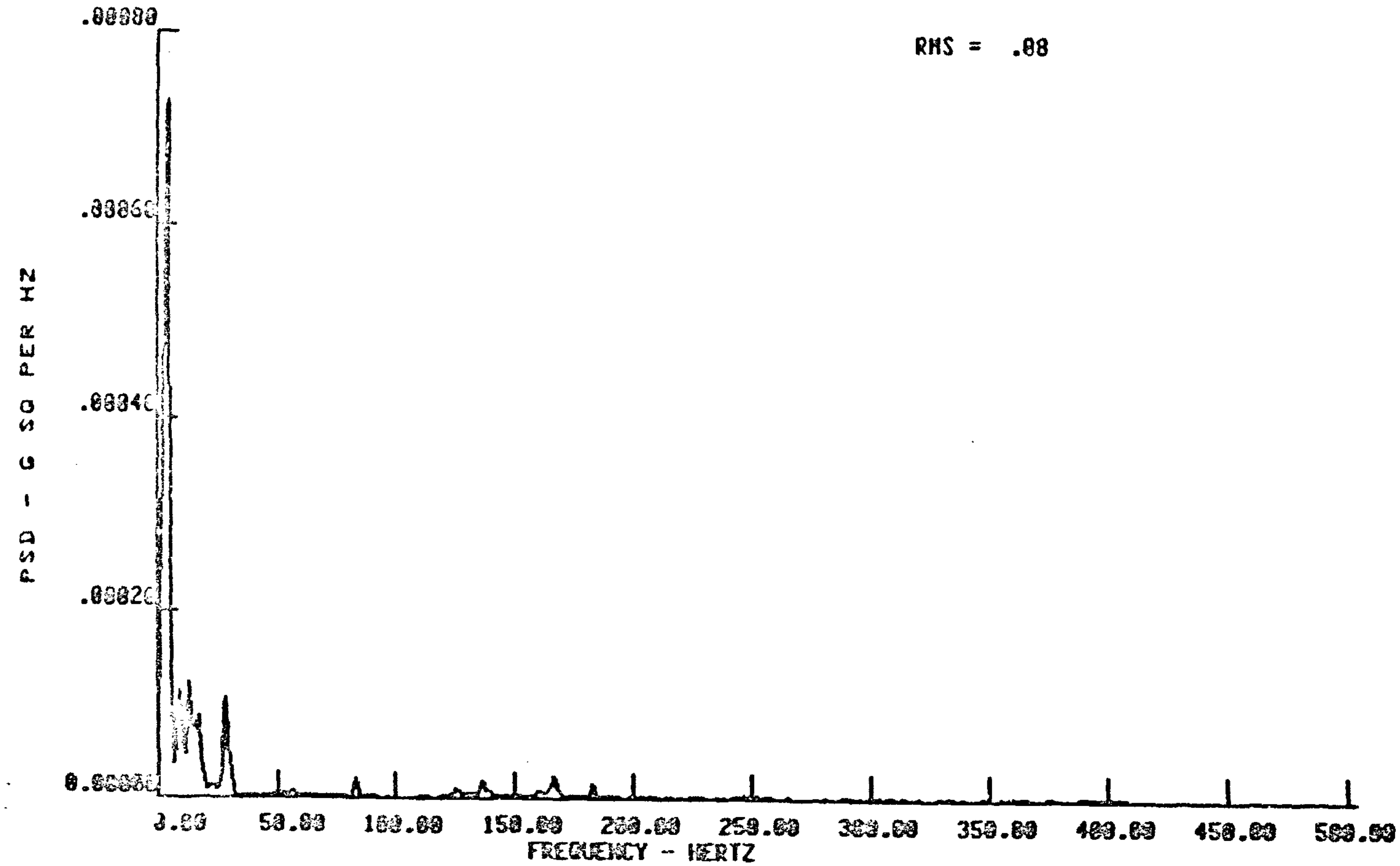
RUN 013 (V) COMPRESSOR TOP (AVE)



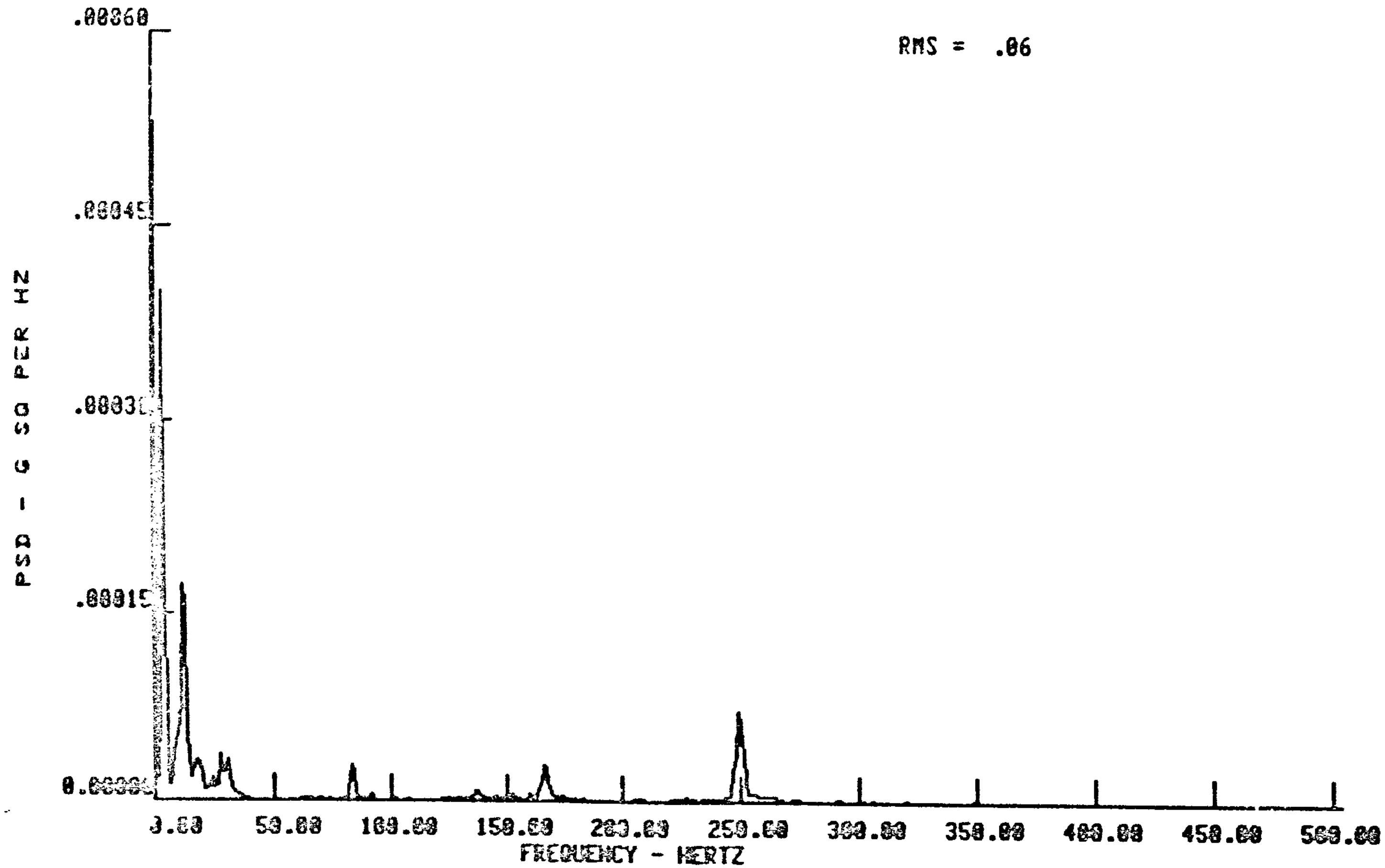

RUN 013 (T) COMPRESSOR TOP (AVE)
RMS = .13
PSD - G SQ PER HZ
.00040
.00030
.00020
.00010
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ


RUN 013 (L) COMPRESSOR TOP (AVE)
RMS = .10
.00080
.00060
.00040
.00020
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

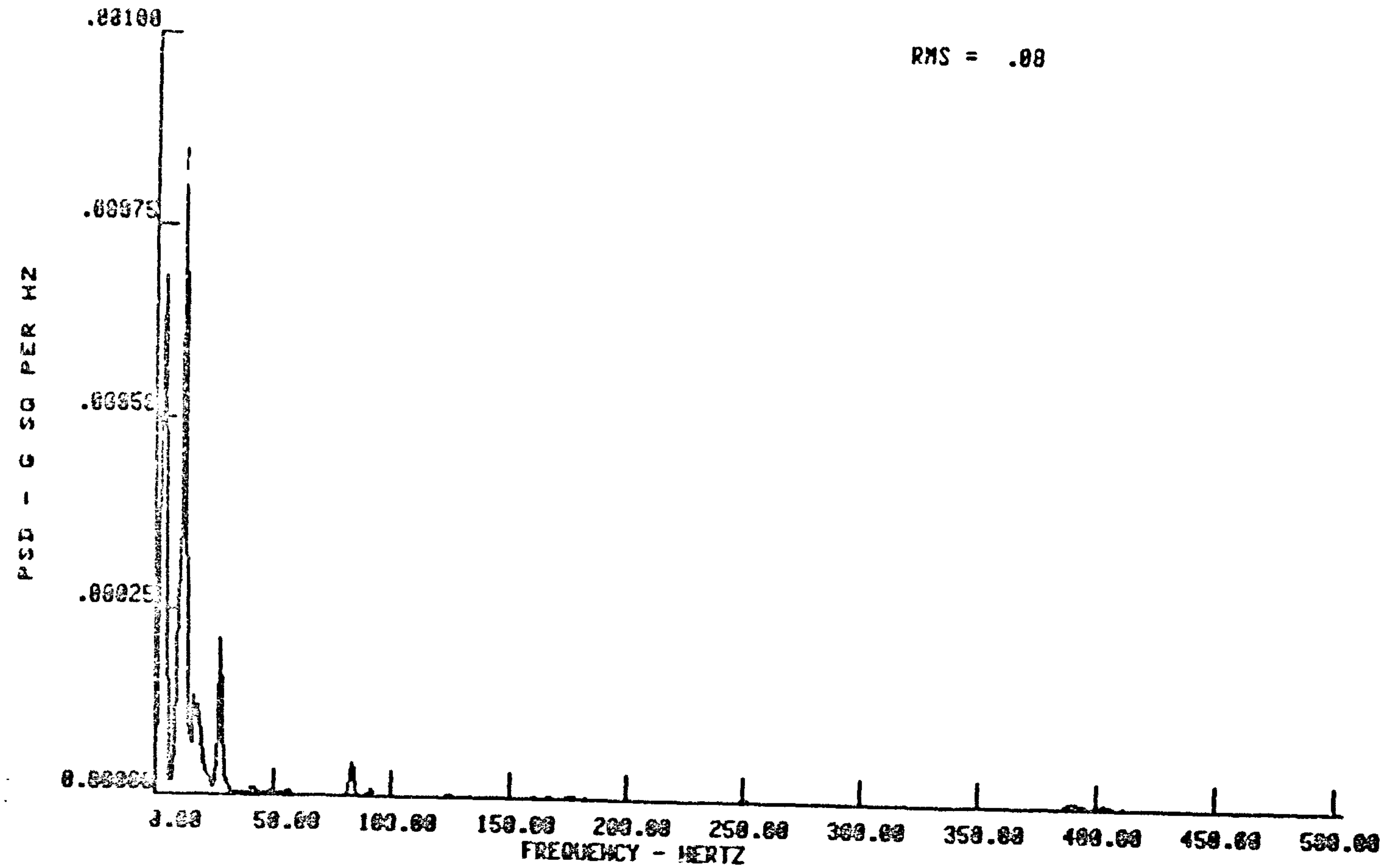
RUN 013 (V) AIR COND MOUNTING BRACKET (AVE)



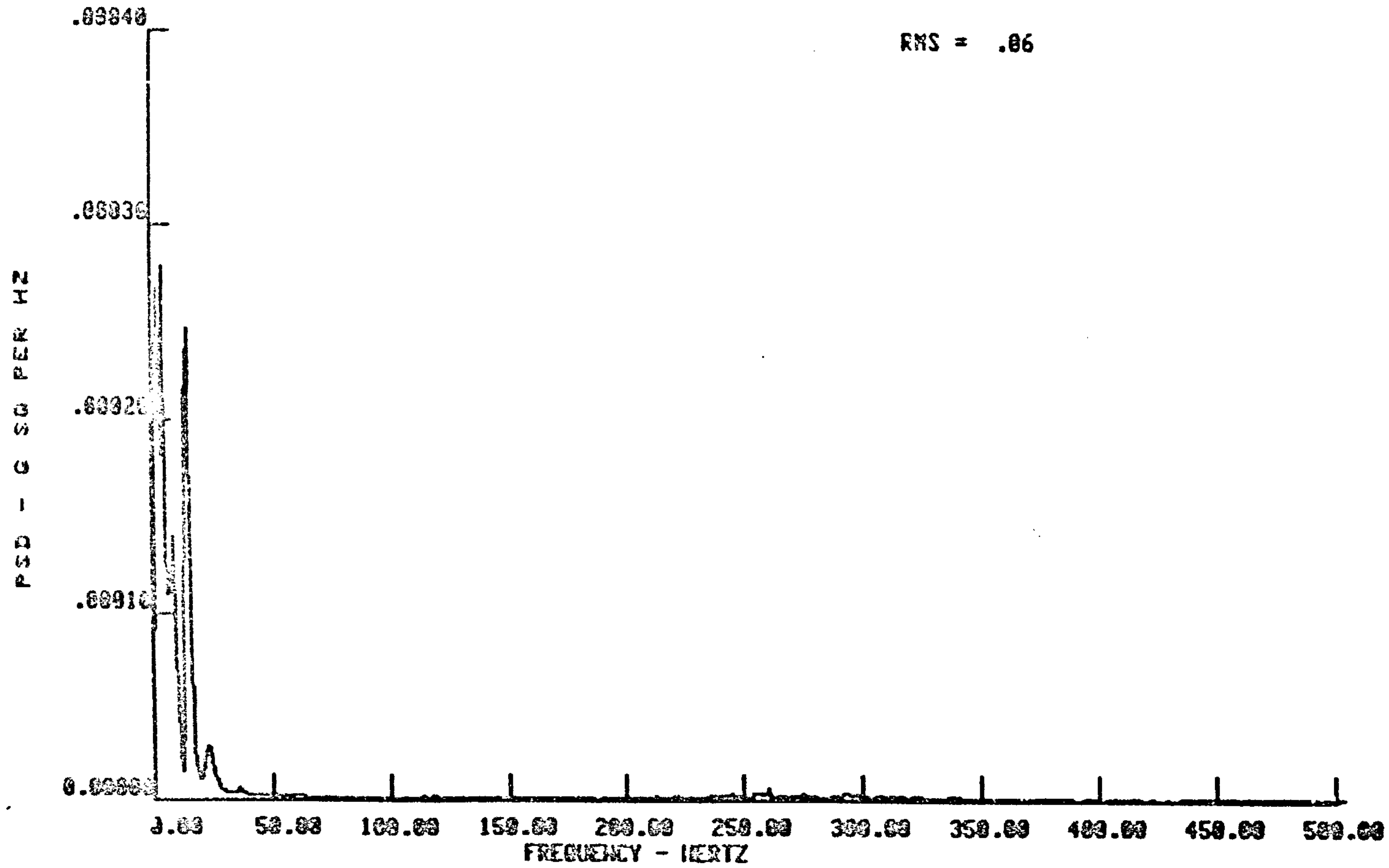
RUN 013 (T) AIR COND MOUNTING BRACKET (AVE)



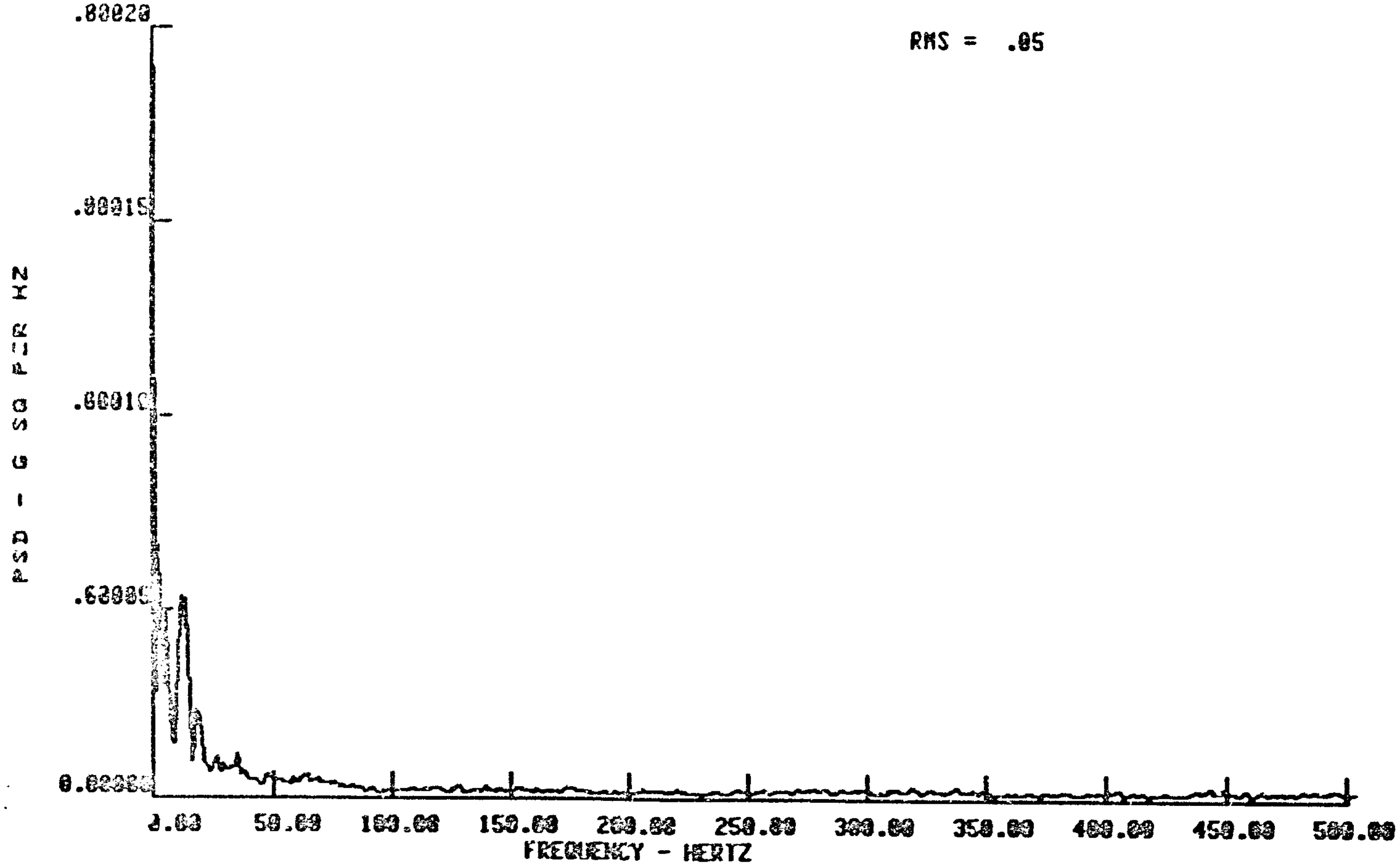
RUN 813 (L) AIR COND MOUNTING BRACKET (AVE)



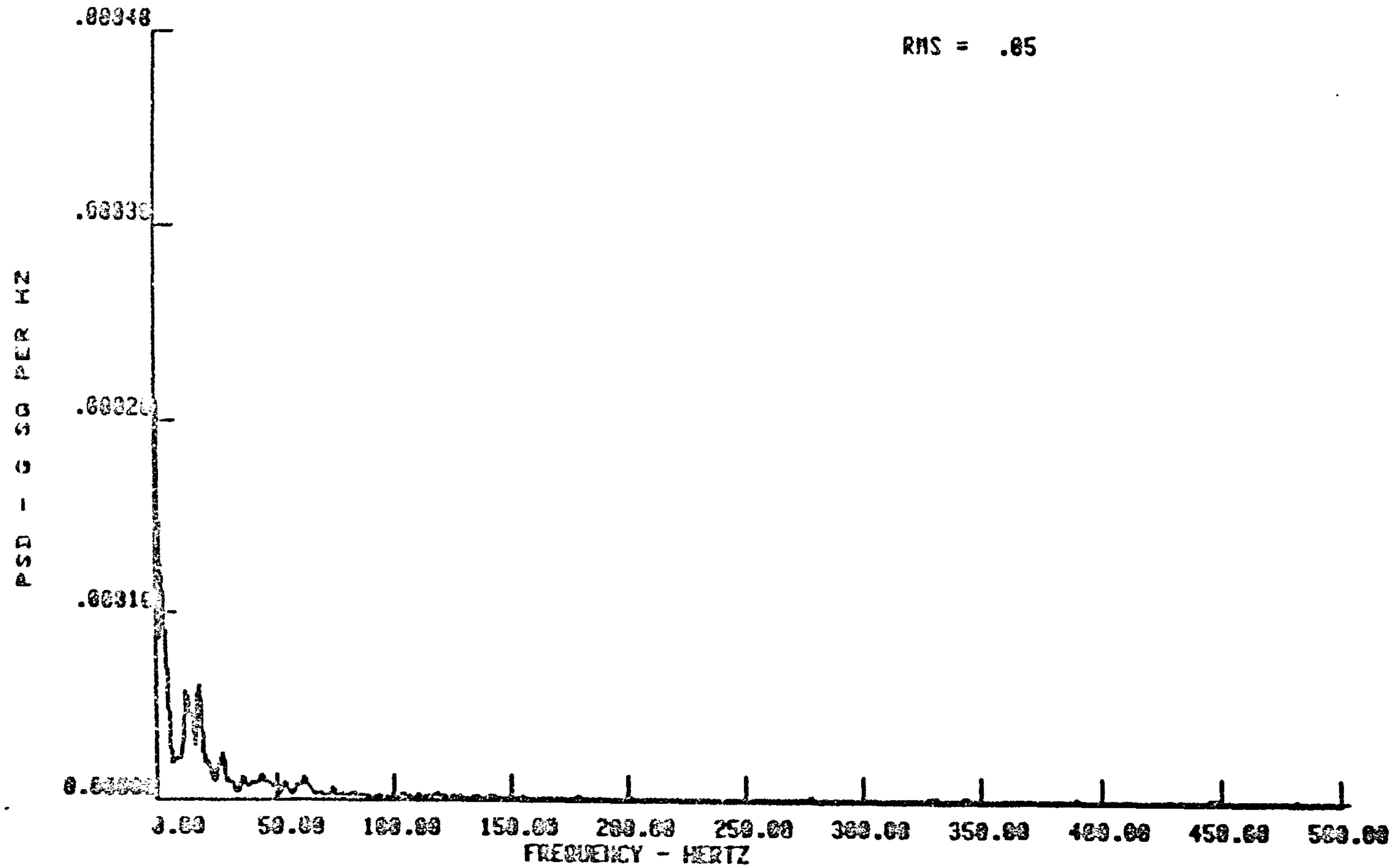
RUN 012 (Y) COMPRESSOR BOTTOM (AVE)



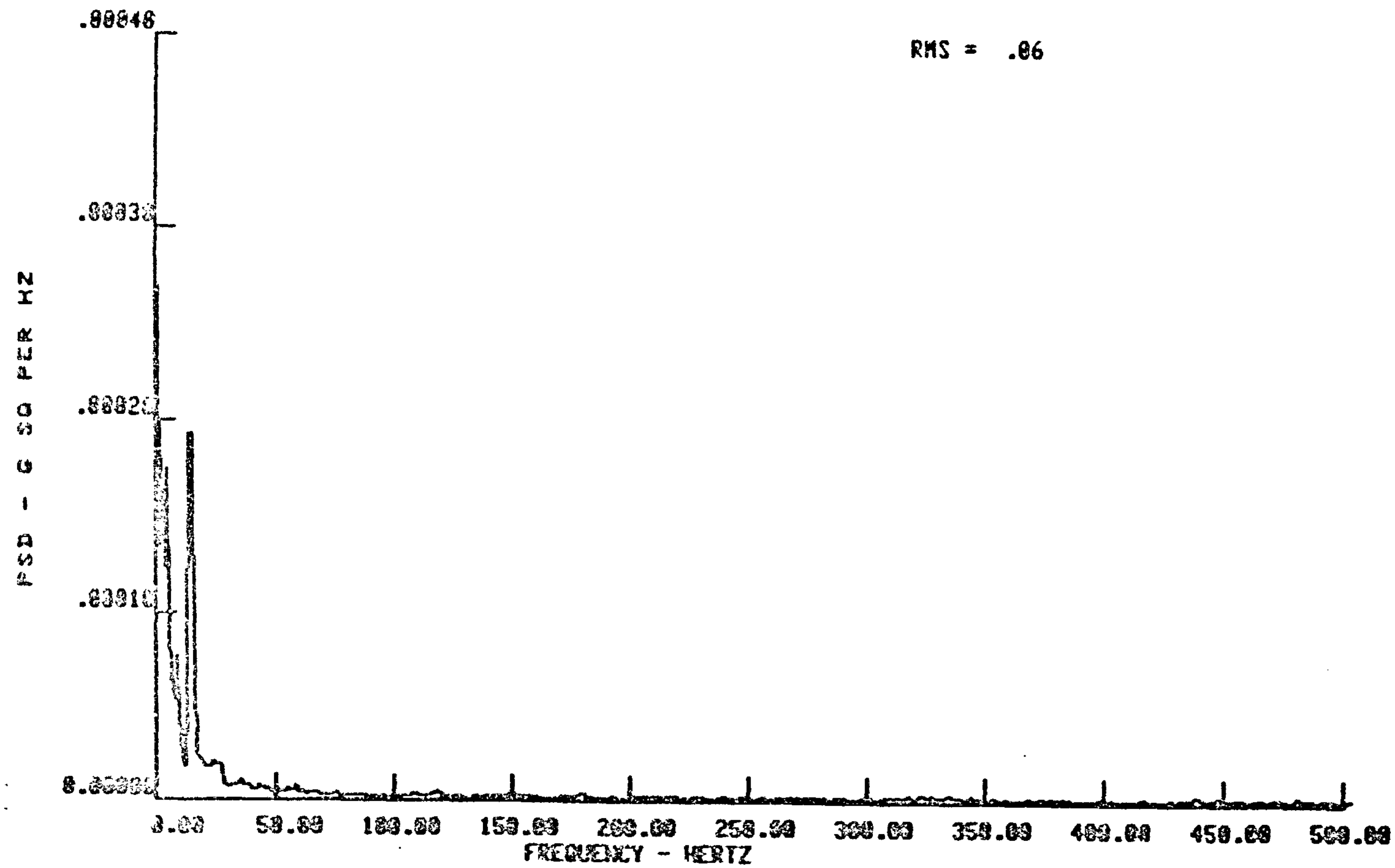
RUN 012 (T) COMPRESSOR BOTTOM (AVE)

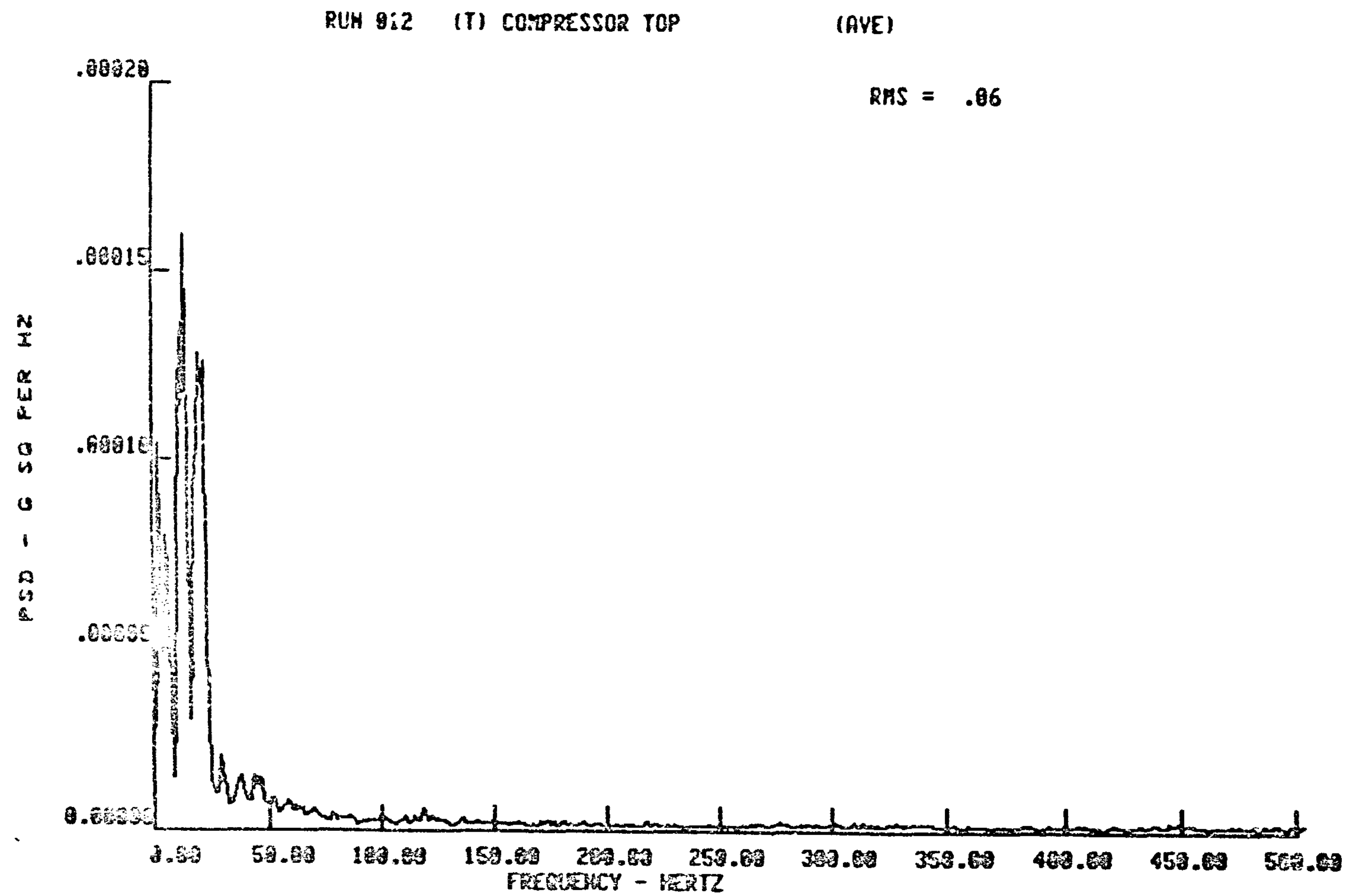


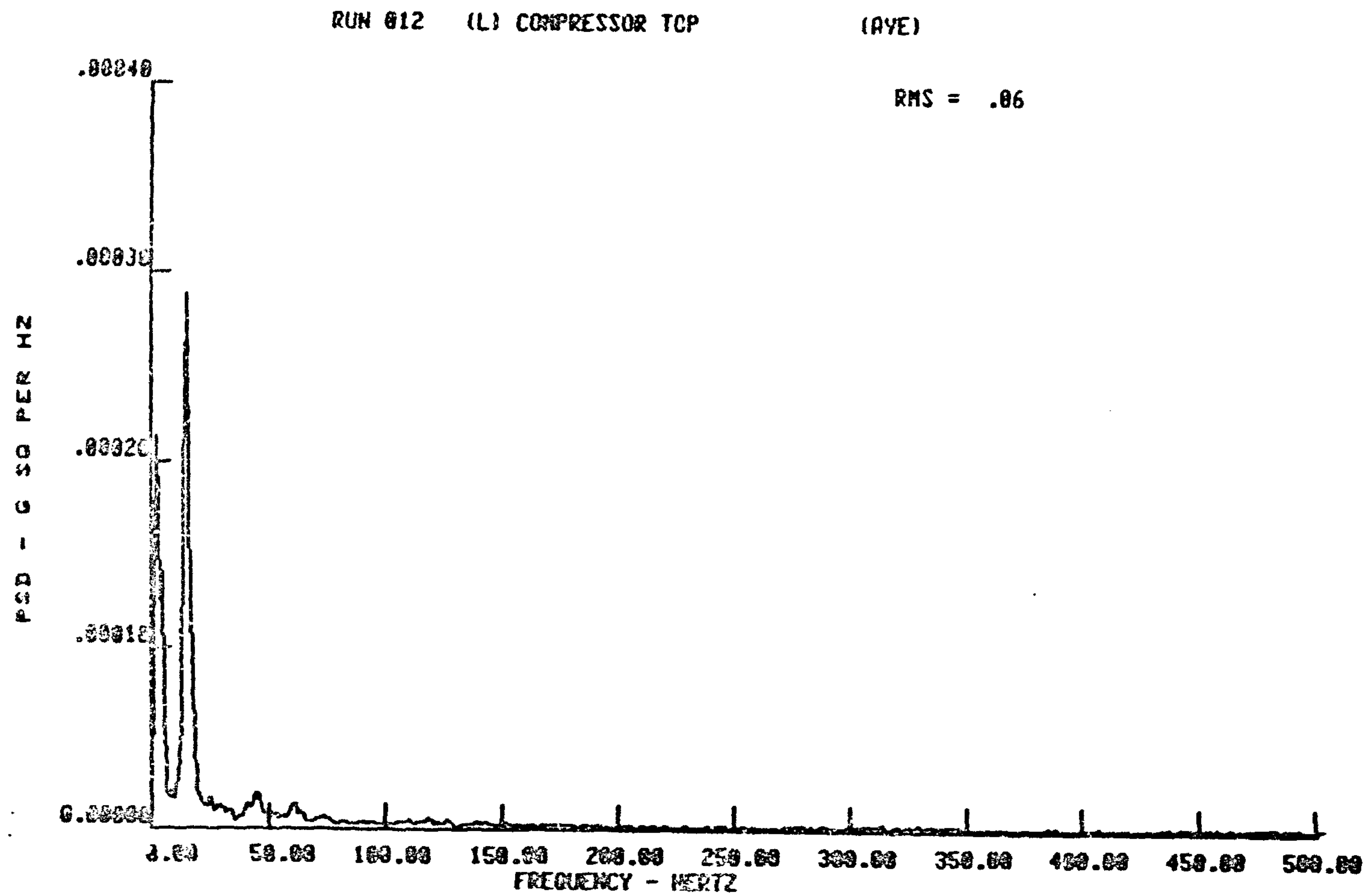
RUN 012 (L) COMPRESSOR BOTTOM (AVE)



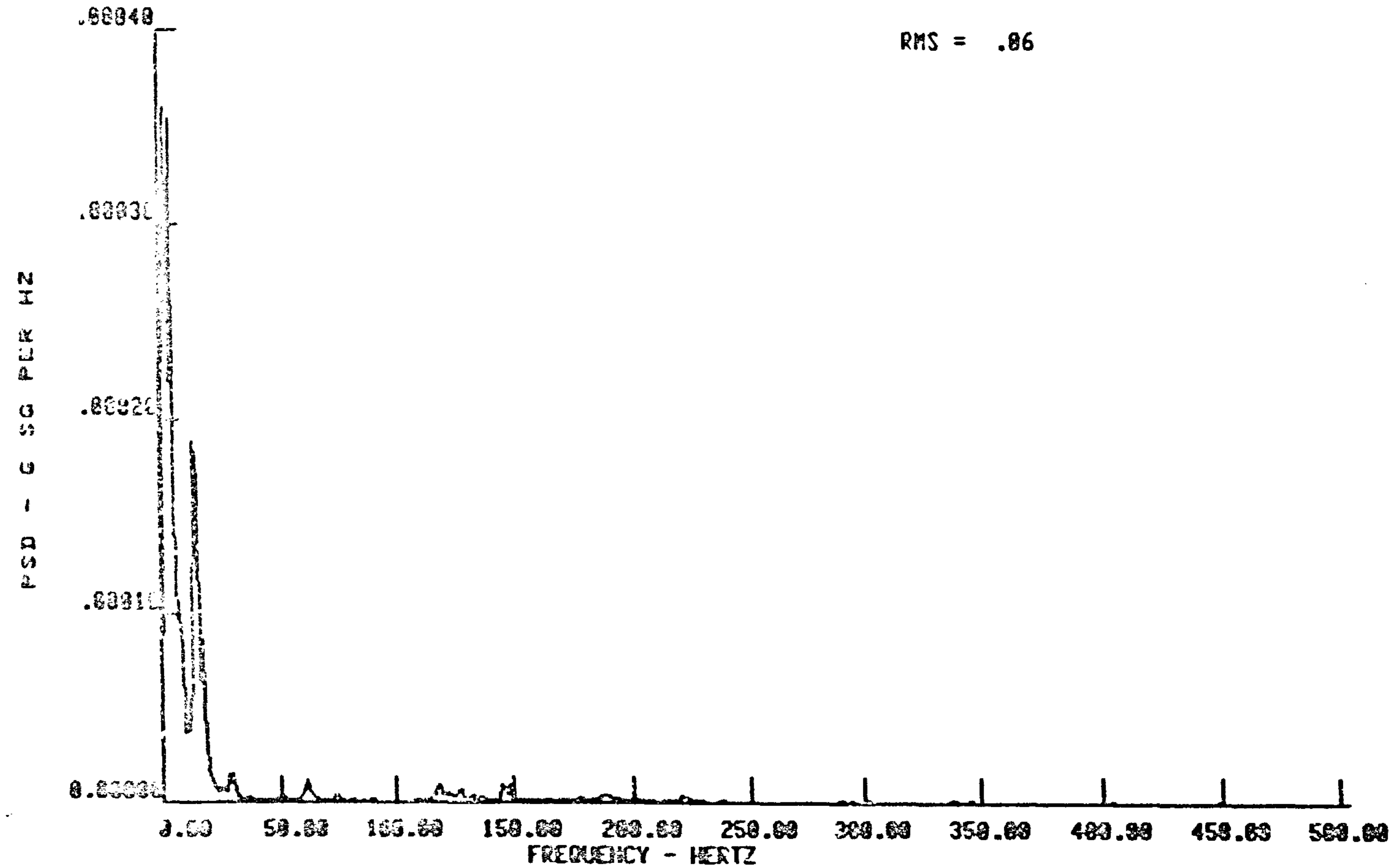
RUN 012 (V) COMPRESSOR TOP (AVE)



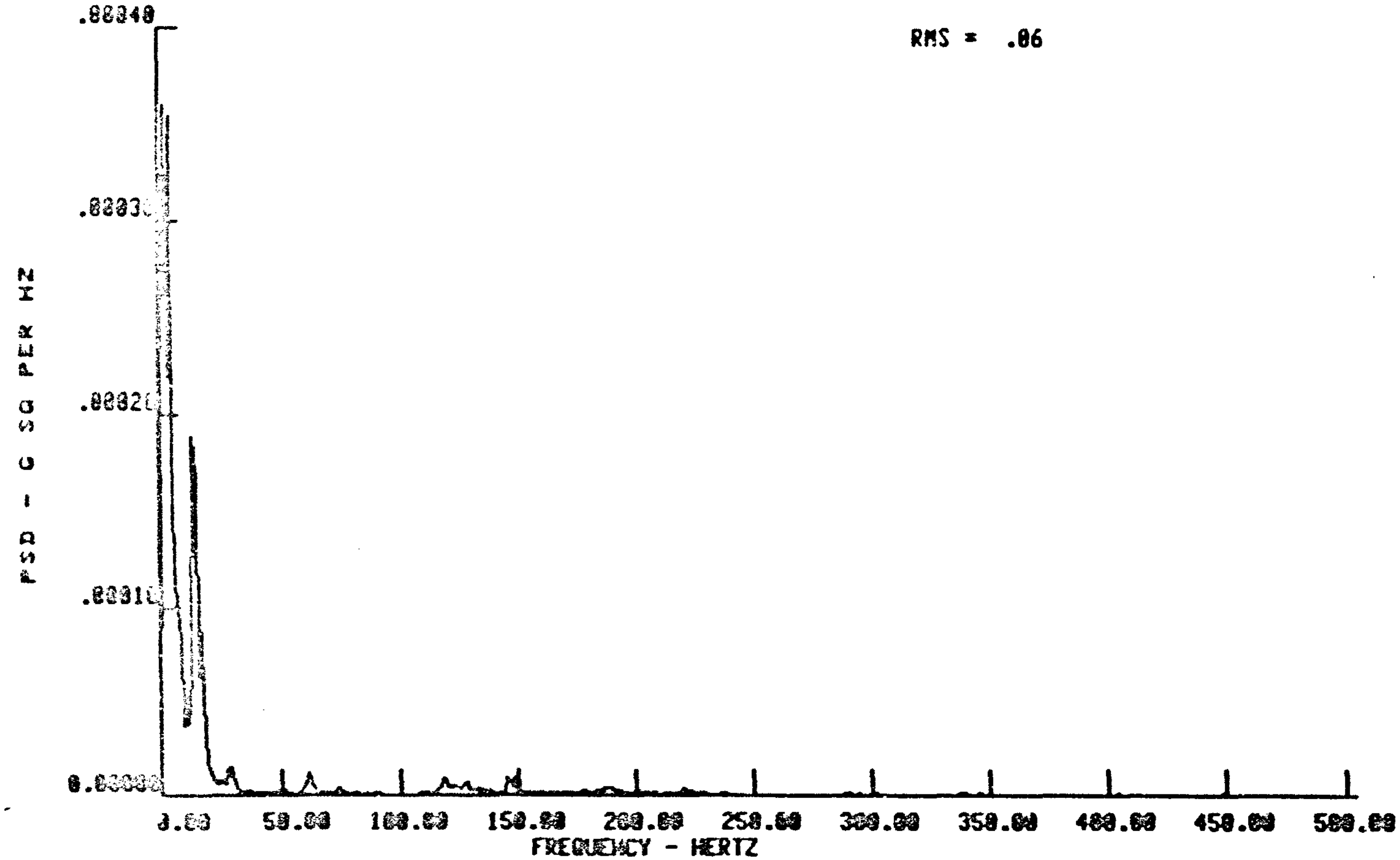

RUN 912 (T) COMPRESSOR TOP (AVE)
RMS = .06
.00020
.00015
.00010
.00005
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

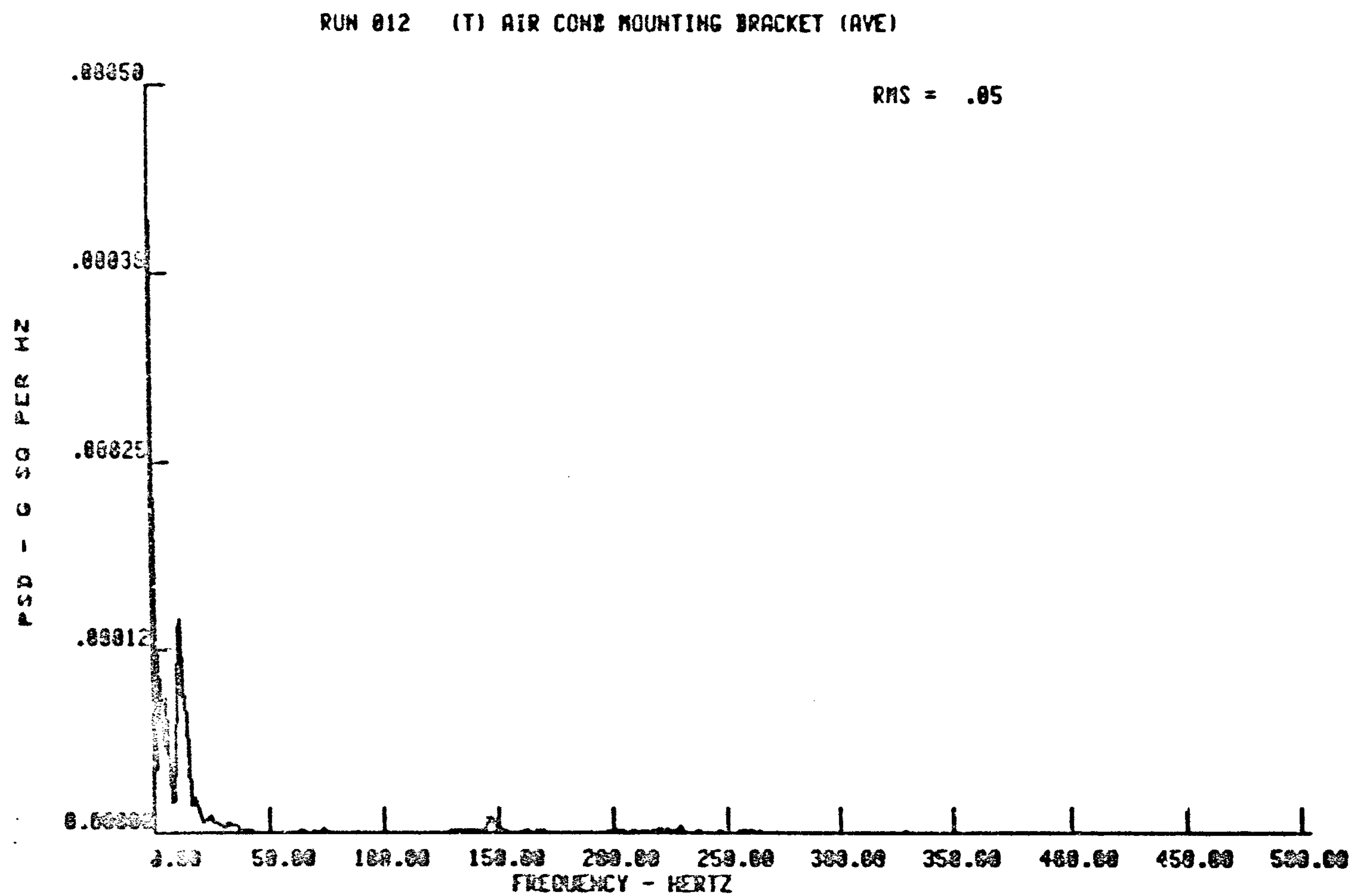

RUN 012 (L) COMPRESSOR TOP (AYE)
RMS = .06
.00040
.00030
.00020
.00010
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

RUN 912 (V) AIR COND MOUNTING BRACKET (AVE)



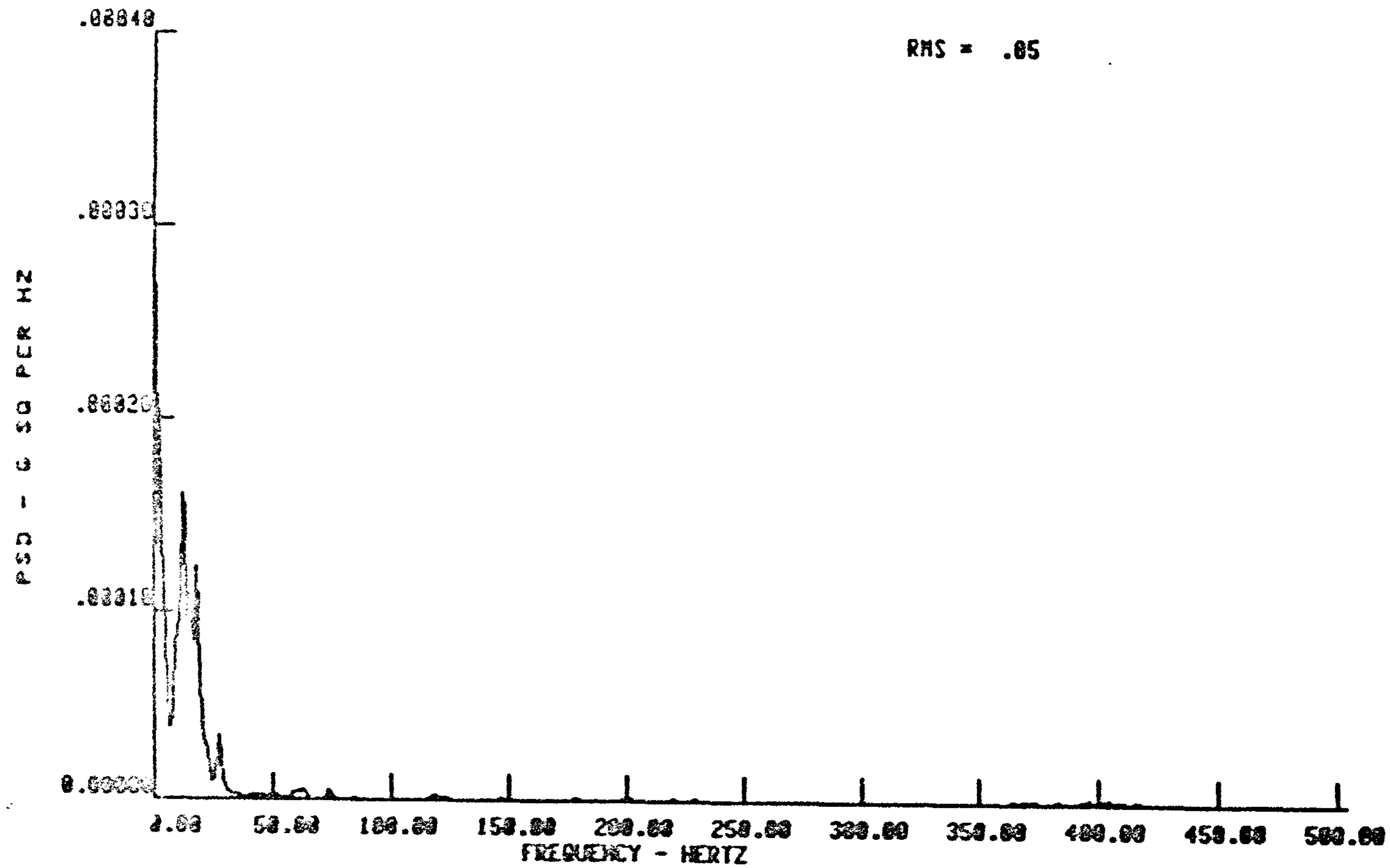
RUN 012 (V) AIR COND MOUNTING BRACKET (AVE)

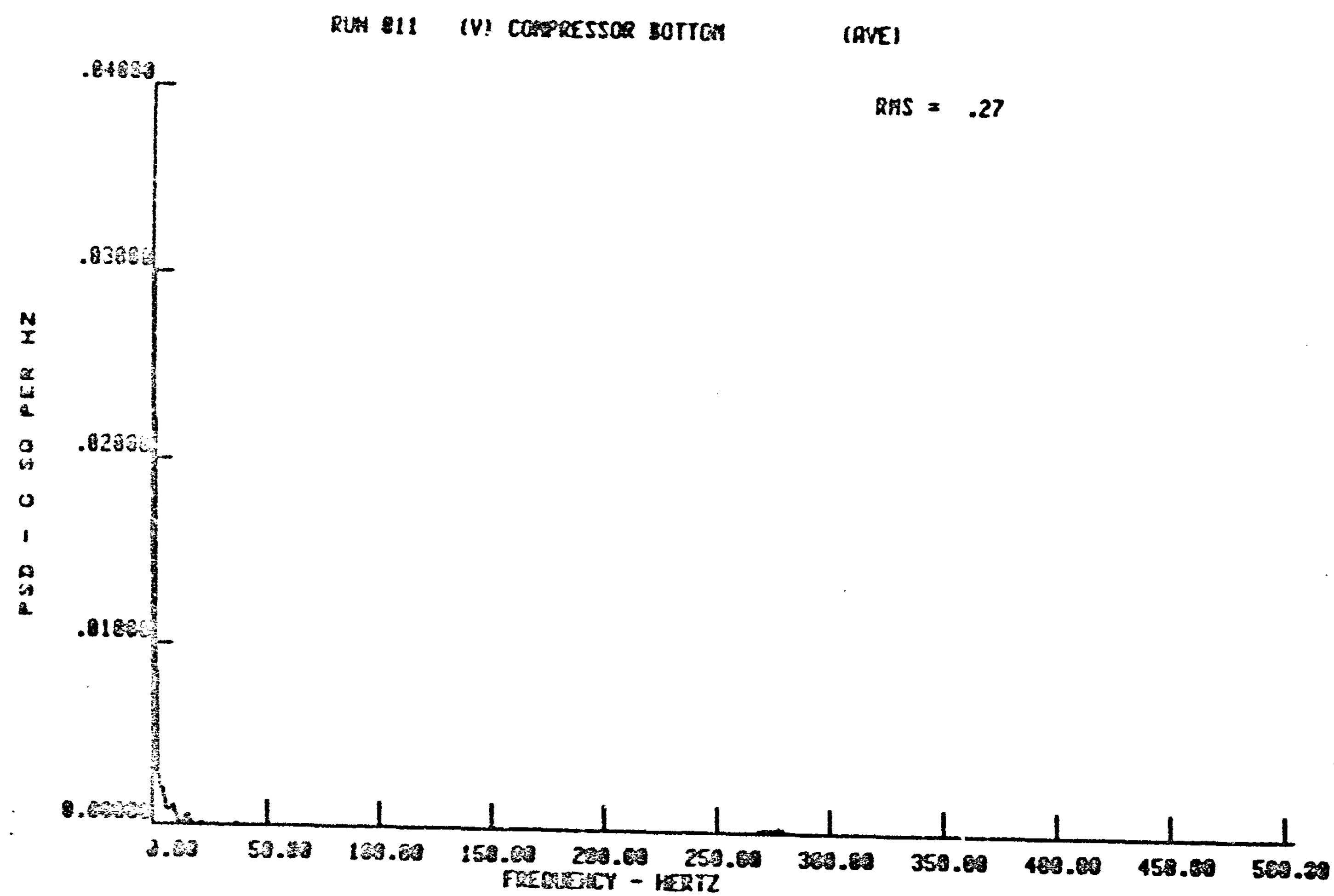




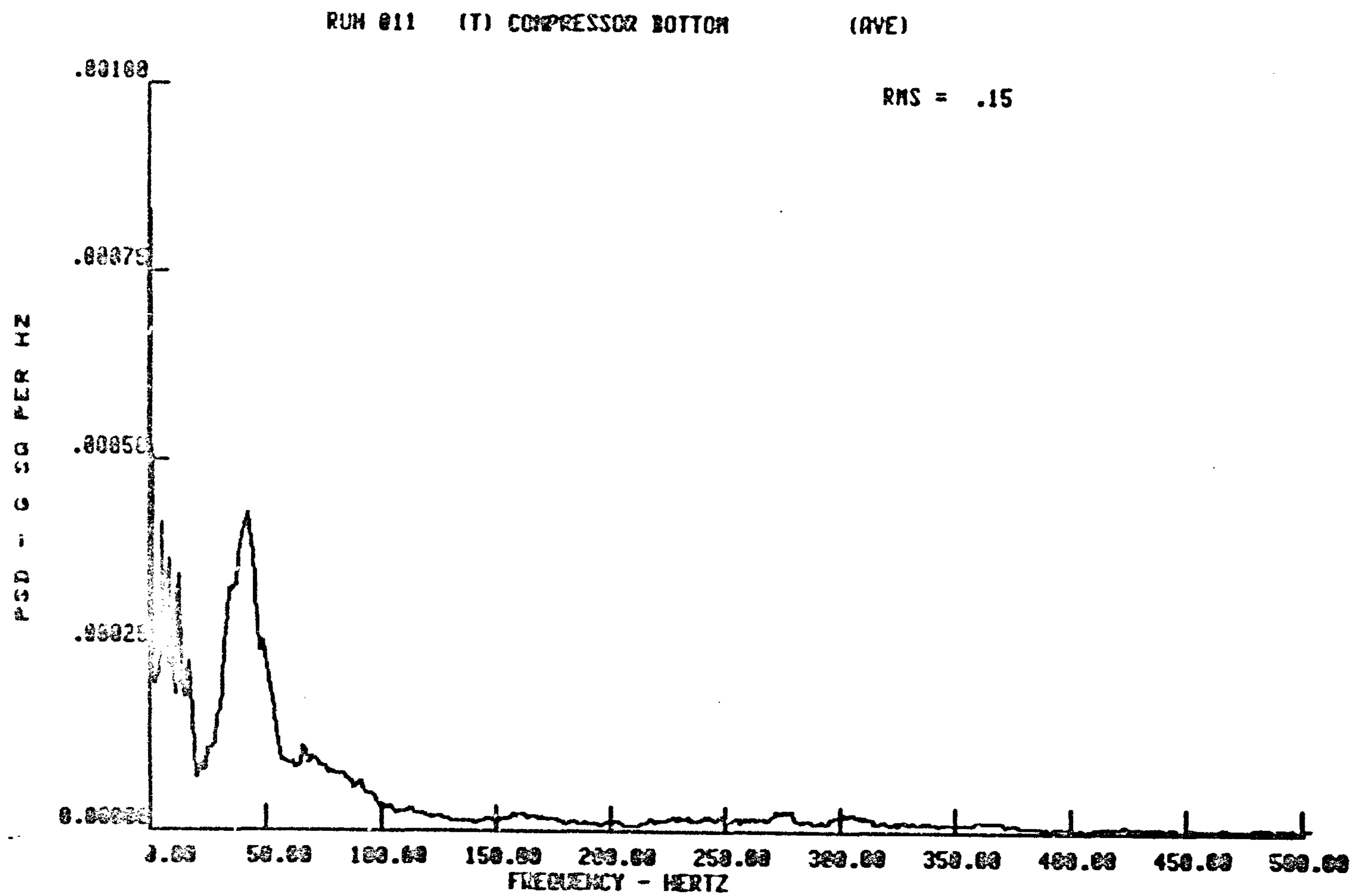
RUN 012 (T) AIR COND MOUNTING BRACKET (AVE)
RMS = .05
PSD - G SQ PER HZ
.00050
.00037
.00025
.00012
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ

RUN 012 (L) AIR COND MOUNTING BRACKET (AVE)

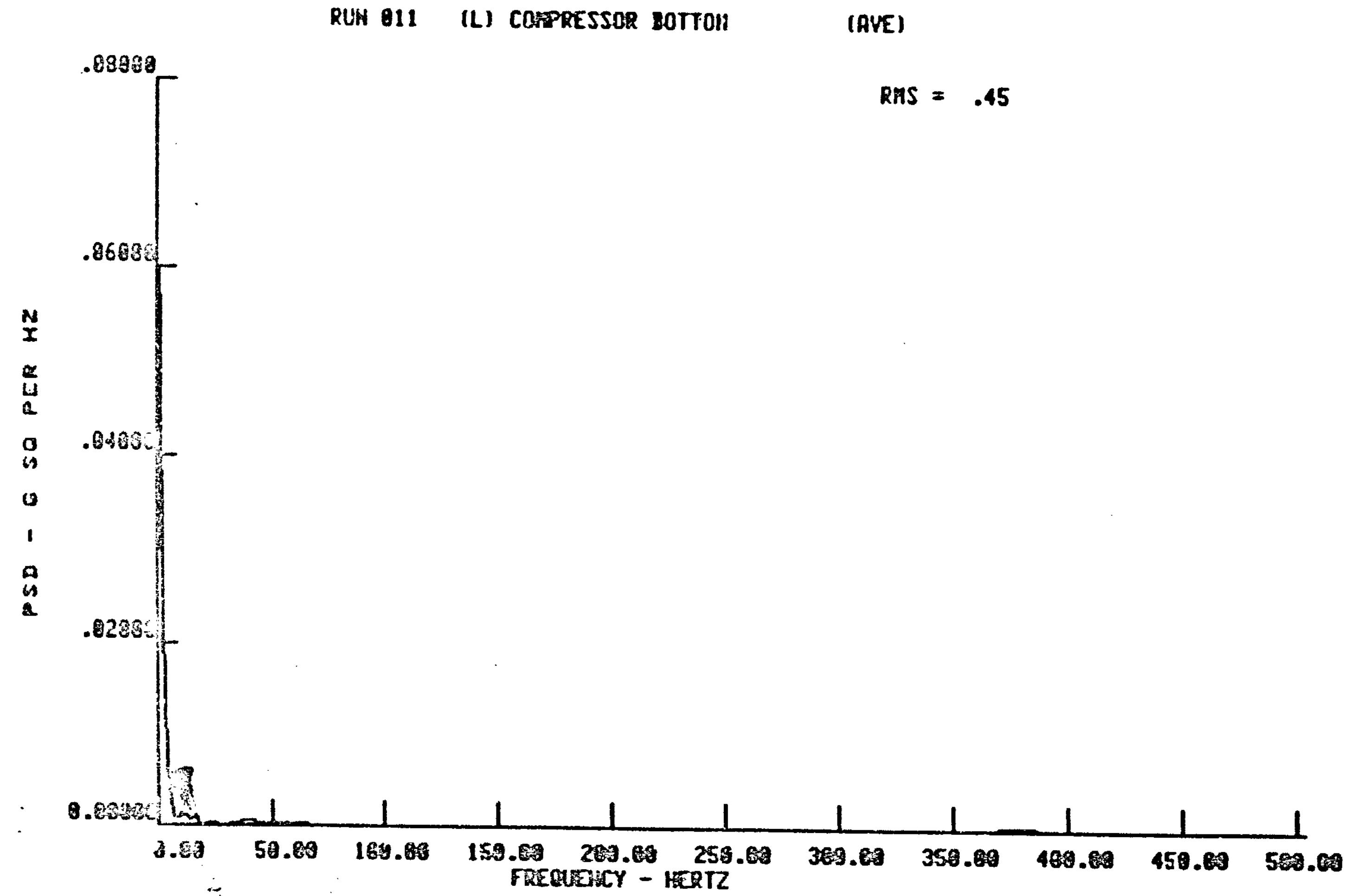




RUN 011 (V) COMPRESSOR BOTTOM (AVE)
RMS = .27
PSD - G SQ PER HZ
.04000
.03000
.02000
.01000
0.00000
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ



RUN 011 (T) COMPRESSOR BOTTOM (AVE)
RMS = .15
.00100
.00075
.00050
.00025
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ


RUN 011 (L) COMPRESSOR BOTTOM (AVE)
RMS = .45
.08000
.06000
.04000
.02000
0.00000
PSD - G SQ PER HZ
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
FREQUENCY - HERTZ